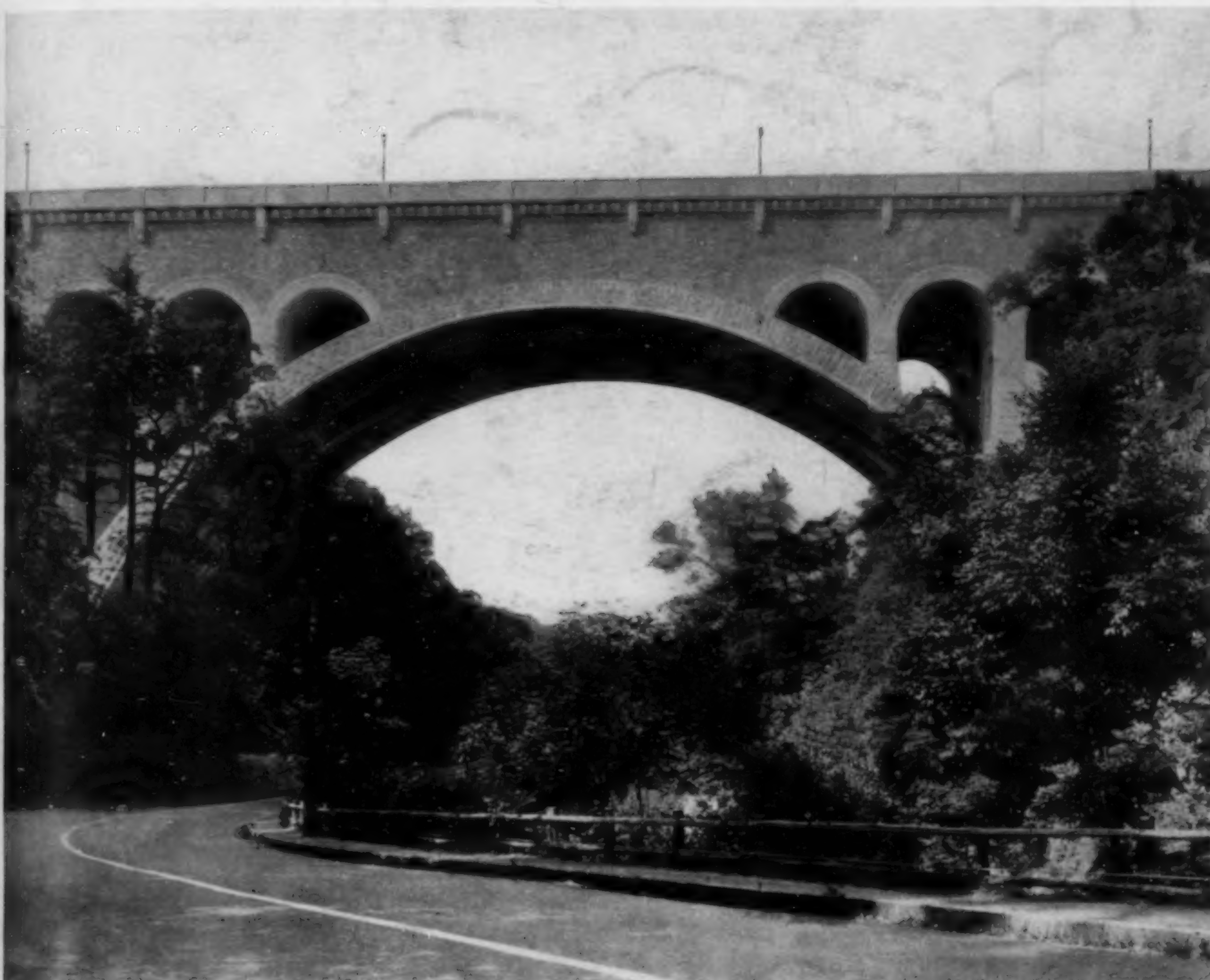
CIVIL ENGINEERING

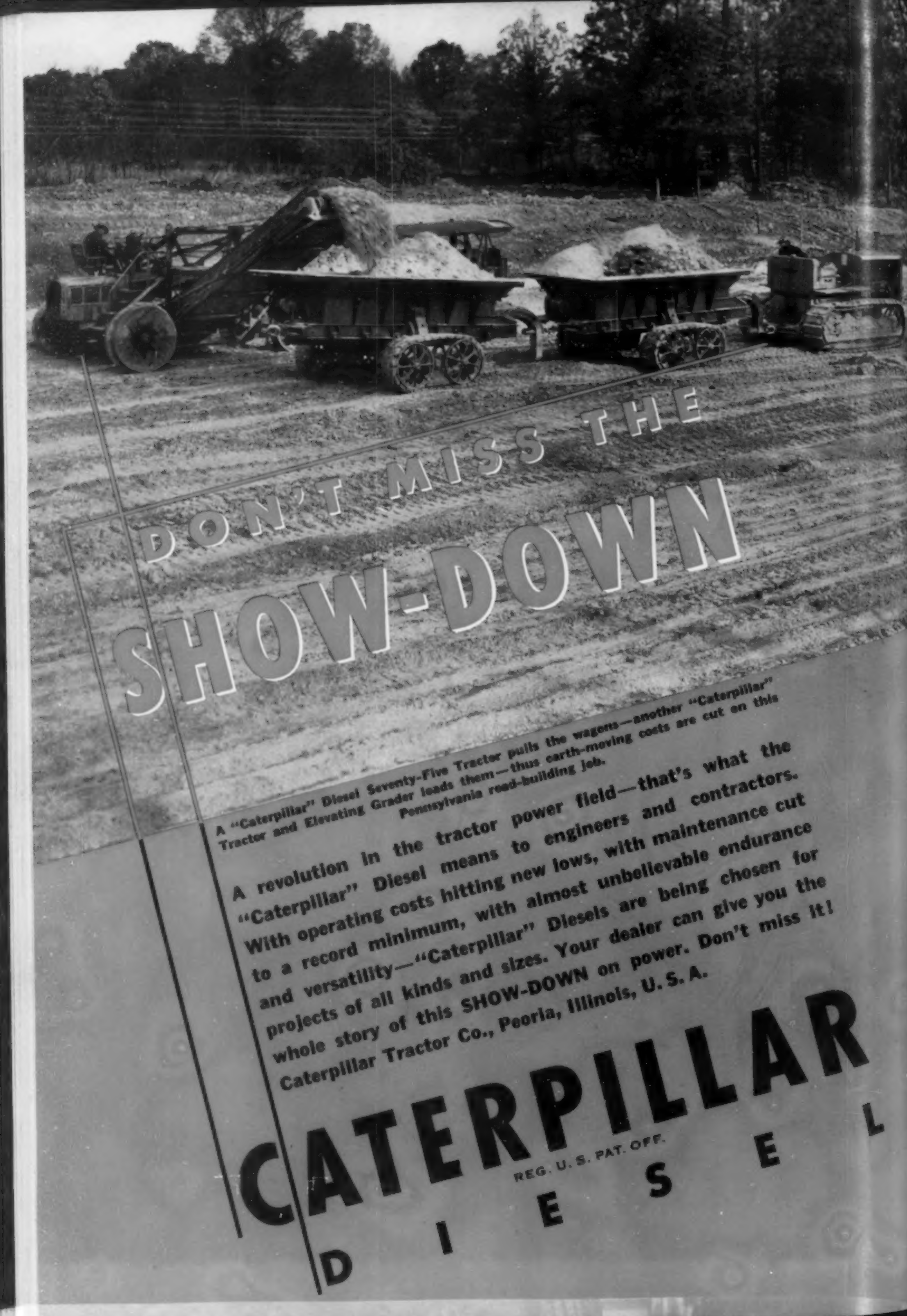
Published by the American Society of Civil Engineers



Henry Avenue Arch Over Wissahickon Gorge, Philadelphia
Aids City Development by Providing Highway Between Sections Separated by Parked Stream Valley

Volume 5 — AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852 — Number 7

JULY 1935


DON'T MISS THE
SHOW-DOWN
A "Caterpillar" Diesel Seventy-Five Tractor pulls the wagons—another "Caterpillar" Tractor and Elevating Grader loads them—thus earth-moving costs are cut on this Pennsylvania road-building job.
A revolution in the tractor power field—that's what the "Caterpillar" Diesel means to engineers and contractors. With operating costs hitting new lows, with maintenance cut to a record minimum, with almost unbelievable endurance and versatility—"Caterpillar" Diesels are being chosen for projects of all kinds and sizes. Your dealer can give you the whole story of this SHOW-DOWN on power. Don't miss it! Caterpillar Tractor Co., Peoria, Illinois, U. S. A.
CATERPILLAR
REG. U. S. PAT. OFF.
DIESEL

Among Our Writers

J. P. Growdon previous to 1925 had been in charge of the design and construction of a number of hydro-electric power developments in the Northwest, including the Skagit River water power project for Seattle, Wash. Since that time he has been connected with the Aluminum Company of America, where he holds the position of assistant chief hydraulic engineer.

John W. Wheeler holds a bachelor's and a technical degree in civil engineering from Purdue University, where he graduated in 1916. His experience includes five years as a highway engineer, two years in the Corps of Engineers during the World War, and ten years as a contractor on highways, sewers, and bridges. For the past two years he has been state highway commissioner and chairman of the State Planning Board of Indiana.

Earle B. Norris has been dean of the school of engineering and director of the Virginia Polytechnic Institute Engineering Experiment Station since 1928. From 1919 to 1928 he held a similar position at Montana State College. Mr. Norris also taught at Pennsylvania State College and at the University of Wisconsin. He served as captain and major in the Ordnance Department during the World War, and in 1919 was chief engineer of the Rock Island Arsenal. He is a member of the American Society of Mechanical Engineers.

John Hedberg holds degrees of civil engineer from Cornell (1929), master of science in civil engineering from Purdue University, and doctor of philosophy from Stanford University, and has taught at each of these institutions at various times. He is now a junior engineer with the U. S. Bureau of Reclamation, stationed at Denver, Colo.

L. A. Schmidt, Jr., after graduating in civil engineering at the University of Wisconsin in 1923, spent $6^1/_2$ years with a Chicago consulting engineer on dam and hydro-electric work. He filled two short engagements as hydro-electric engineer with the Michigan Public Service Company and the Central Texas Hydro-Electric Company before studying for a master's degree at the University of Texas, received in 1933. Thereafter Mr. Schmidt went with the Texas Relief Commission as designing engineer for the parks division on CWA and FERA work, in which capacity he designed the bridge described in this issue.

Thomas Buckley has had a long career in public service, principally with the City of Philadelphia, where he is now assistant chief engineer and surveyor in the Bureau of Engineering, Surveys, and Zoning, and vice-president of the Board of Surveyors. He has also been active in associations of public works engineers, serving at present as vice-president of the American Society of Municipal Engineers and vice-chairman of the Administrative Board, Joint Secretariat of the American Society of Municipal Engineers and International Association of Public Works Officials.

Theodore J. Hoover became a member of the mining and metallurgy faculty of Stanford University in 1919, after 18 years spent in the active development and operation of mines in the United States, Australia, Mexico, Russia, and Burma. Since 1925 he has been dean of engineering at Stanford. Mr. Hoover is the author of the books *Concentrating Ores by Flotation*, and *Economics of Mining*, and is a member of the American Institute of Mining and Metallurgical Engineers.

Volume 5 Number 7

July 1935

Entered as second class matter September 23, 1930, at the Post Office at Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

CIVIL ENGINEERING

Published Monthly by the

American Society of Civil Engineers

(Founded November 5, 1852)

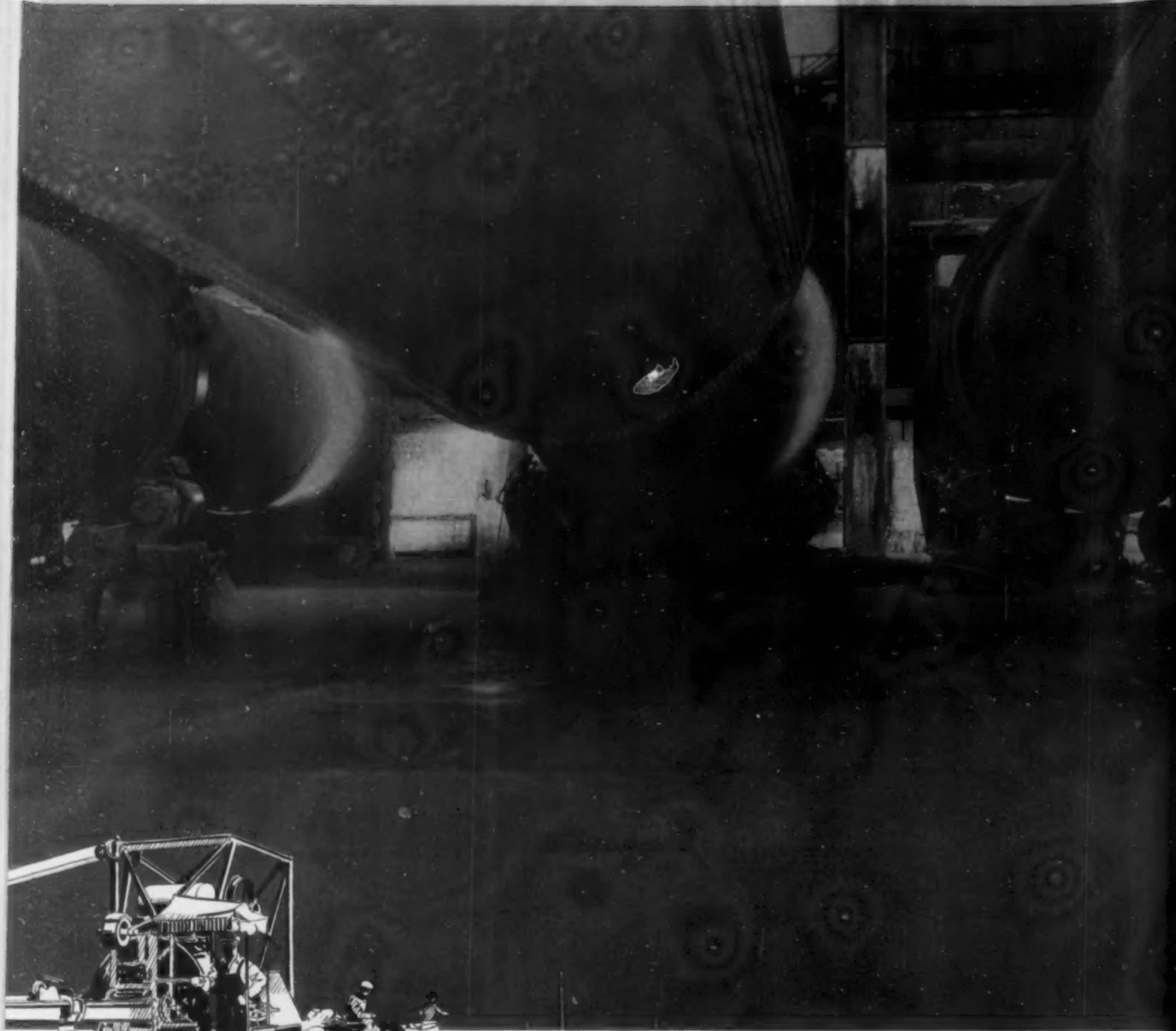
Publication Office: 20th and Northampton Streets, Easton, Pa.
Editorial and Advertising Departments:
33 West 39th Street, New York

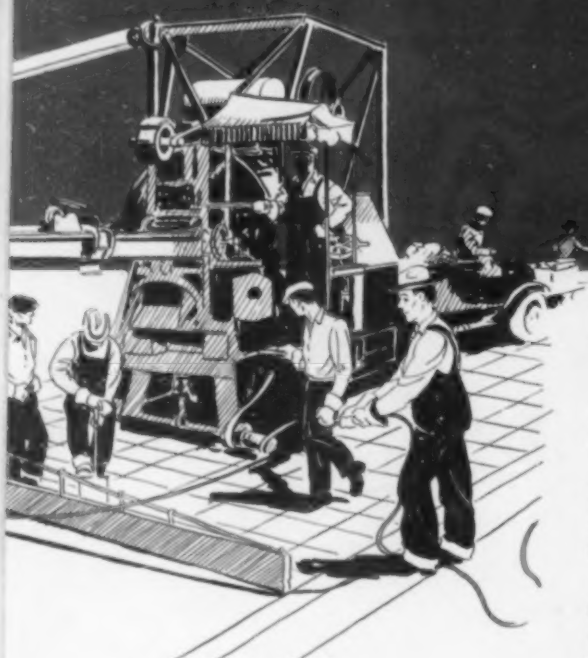
This Issue Contains

Subscription Rates

Price, 50 cents a copy; $5.00 a year in advance; $4.00 a year to members and to libraries; and $2.50 a year to members of Student Chapters. Canadian postage 75 cents and foreign postage $1.50 additional.

Member of Audit Bureau of Circulations





Arthur S. Tuttle
President
George T. Seabury
Secretary
Sydney Wilmot
Manager of Publications
P. H. Carlin
Editor
Volume 5

CIVIL ENGINEERING

July 1935

Committee on Publications
Henry J. Sherman
Chairman
O. H. Ammann
Frank A. Barbour
Charles B. Burdick
W. W. Horner
W. L. Glenzing
Advertising Manager
Number 7

Power Developments on the Little Tennessee

Various Types of Arched Dams Designed to Meet Local Conditions

By J. P. Growdon

Member American Society of Civil Engineers
Assistant Chief Hydraulic Engineer, Aluminum Company of America, Pittsburgh, Pa.

Rising in the Blue Ridge Mountains of northern Georgia and flowing northeast through North Carolina and Tennessee before joining its larger namesake, the Little Tennessee presents some ideal sites for power development. The Aluminum Company of America early realized the hydro-electric possibilities of this stream, and in 1919 completed its first step to secure power for aluminum reduction by building a gravity-type concrete dam at Cheoah. This structure is 230 ft high and when constructed was the highest dam in the world over which large volumes of water flowed. One feature was an early use of the hydraulic jump to prevent erosion. To develop more power and minimize irregularities in its amount, the company in 1928 constructed the Santeetlah Dam across the Cheoah, a tributary of the Little Tennessee, and in 1930 the Calderwood Dam, 9 miles below Cheoah. The latter structure is also of interest because it employs a U-shaped deflector at the bottom of the stilling pool, doubling the effective depth. Models for both hydraulic jump and deflecting devices were built and tested before the dams were constructed. This article is abstracted from a paper delivered by Mr. Growdon at the joint meeting of the Tennessee Valley and Mid-South Sections held November 8 to 10, 1934, at Knoxville, Tenn.

Recently the Tennessee Valley has attracted the attention of the whole country because of the new and interesting projects being carried out there. The engineering profession is particularly interested in the hydro-electric developments under construction and projected by the Tennessee Valley Authority and likewise in those already completed by the Aluminum Company of America on the Little Tennessee River.

Reduction of metallic aluminum from its ore, in common with other metallurgical industries, requires large amounts of electric power. The Aluminum Company of America, which has always endeavored to prepare in advance for an increasing use of its product, foresaw the time when its power facilities at Niagara Falls and Massena, N.Y., would be inadequate. After studying many different power possibilities, the Tennessee Valley was selected as the site for future developments. In 1910 it began the purchase of lands and riparian rights along the Little Tennessee River and its tributaries, for the purpose of constructing its aluminum works and the hydro-electric plants required to operate them. The watershed on the Little Tennessee is mountainous and forested, with steep slopes, swift streams, and heavy rainfall. Twenty-five years ago the people of this area were isolated on small unproductive mountain farms, practically without roads, and had no opportunity to augment the income from their farms by outside work. The aluminum industry has been an important factor in promoting the very remarkable improvement that has taken place in the area since the industry was first established there. From the first, the company planned for a logical and economic development of the Little Tennessee watershed, and its hydro-electric plants have been built in accord with that plan.

The aluminum works at Alcoa, Tenn., receives its power from a group of three plants, Cheoah, Santeetlah, and Calderwood, located about 50 miles above the mouth of the Little Tennessee River, in the edge of the Great Smoky Mountains on both sides of the Tennessee-North Carolina line. The plan and profile, Figs. 1 and 2, show that these plants are hydraulically, as well as electrically interconnected. The principal storage is provided by the Santeetlah plant, located on the Cheoah

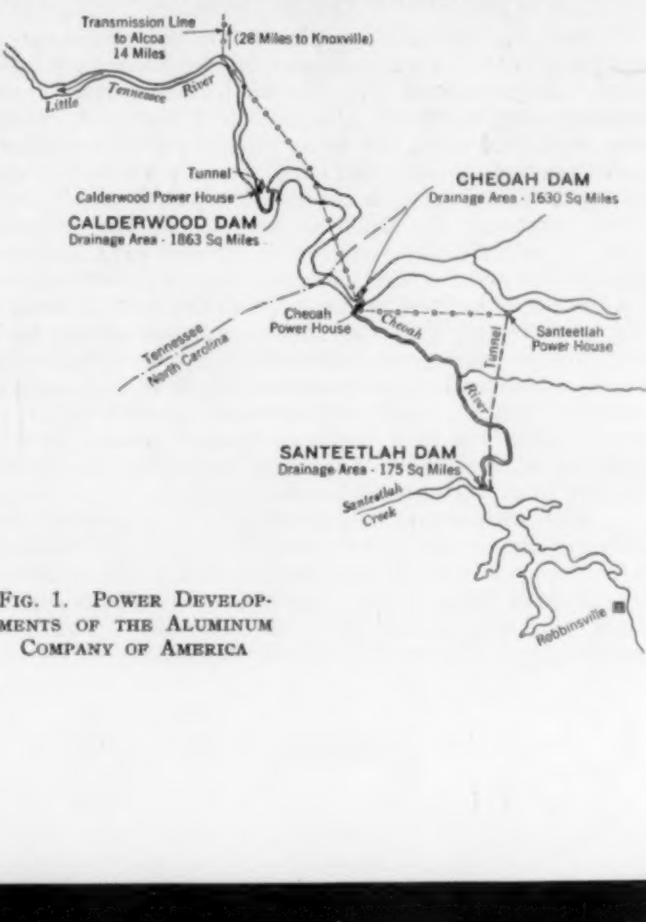
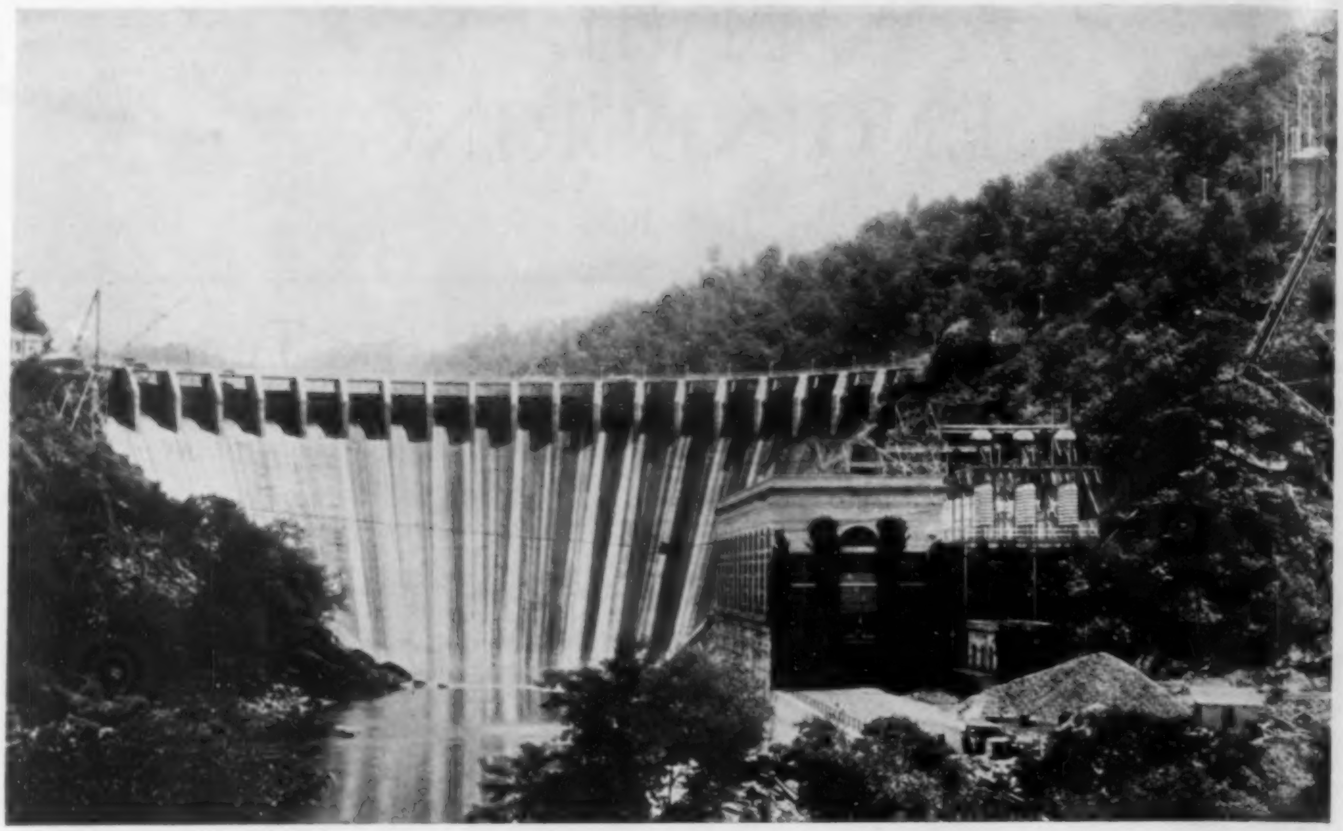


Fig. 1. Power Developments of the Aluminum Company of America



CHEOAH ARCHED OVERFLOW DAM AND POWER HOUSE

River, 10 miles above its mouth. The water stored in the Santeetlah Reservoir, which has a maximum elevation of 1,817 ft, is used by all three plants through a total head of 1,069 ft, without any loss of head. All these plants are similar; each consists essentially of a dam, a tunnel, a surge tank, and a power house, although the details have been varied to suit the particular site and to take advantage of the progress in the art of hydro-electric design that has taken place during the period of their construction.

CHEOAH POWER PLANT

Cheoah, the first of these plants, was completed early in 1919. It is in a narrow gorge on the main river just above the mouth of the Cheoah. This gravity-type concrete dam, arched in plan, is 230 ft high and 770 ft long, measured along the crest. Flood waters are taken over the crest through 19 Tainter gates, each 25 ft wide by 19 ft high, having a combined capacity of 160,000 cu ft per sec. The drainage area above the dam is 1,630 sq miles. The reservoir is 7 miles long, has an area of 700 acres, and a useful storage of 7,500 acre-ft. The intake is located in the ledge at the left abutment and is provided with the customary trash racks and Stoney-type head-gates. The intake is connected with a surge chamber by a pressure tunnel, 27 ft in diameter and 450 ft long, lined with reinforced concrete. The surge chamber is in a V-shaped tongue of rock at the junction of the Little Tennessee and Cheoah rivers, directly above the power house.

A spillway permits rejected water to pass into the Cheoah River. From the surge chamber, four steel penstocks, 13 ft 6 in. in diameter and approximately 200 ft long, slope steeply down to the turbine level. They are solidly embedded in concrete. Water is admitted to each penstock through a single Stoney-type gate, which is motor-operated and remote-controlled. The power house is a reinforced concrete structure of several stories, on the left bank of the river 400 ft below the dam. It is designed to be safe against flood water 20 ft above the floor of the generator room. It contains four vertical units, each consisting of a Francis turbine, having a capacity of 27,000 hp at $171^1/_2$ rpm, designed for a maximum head of 190 ft, and taking 1,575 cu ft per sec at a normal operating head of 183 ft. The turbine is direct-connected to a 3-phase, 60-cycle, 13,200-v 20,000-kva generator having a 90 per cent power factor, with direct-connected exciter. Each transformer bank consists of three 7,000-kva, single-phase, 13,200/154,000-v, oil-insulated, water-cooled transformers. The usual complement of switches, meters, and auxiliaries is provided for the convenient and flexible operation of the station. The Cheoah develop-

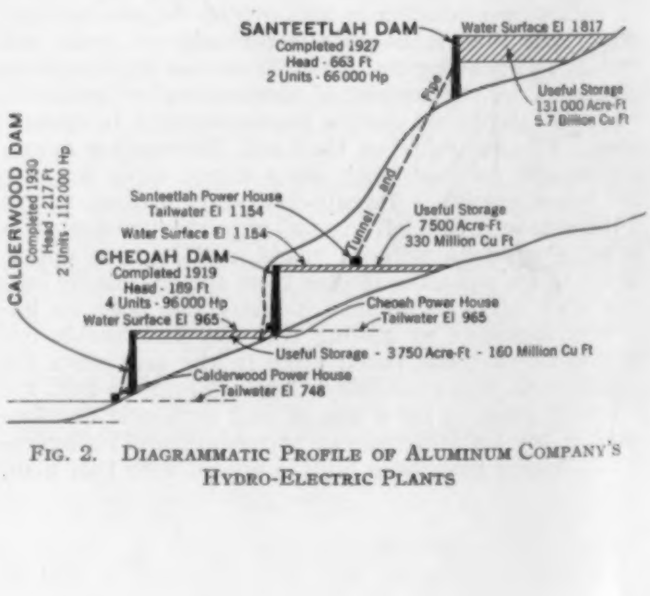
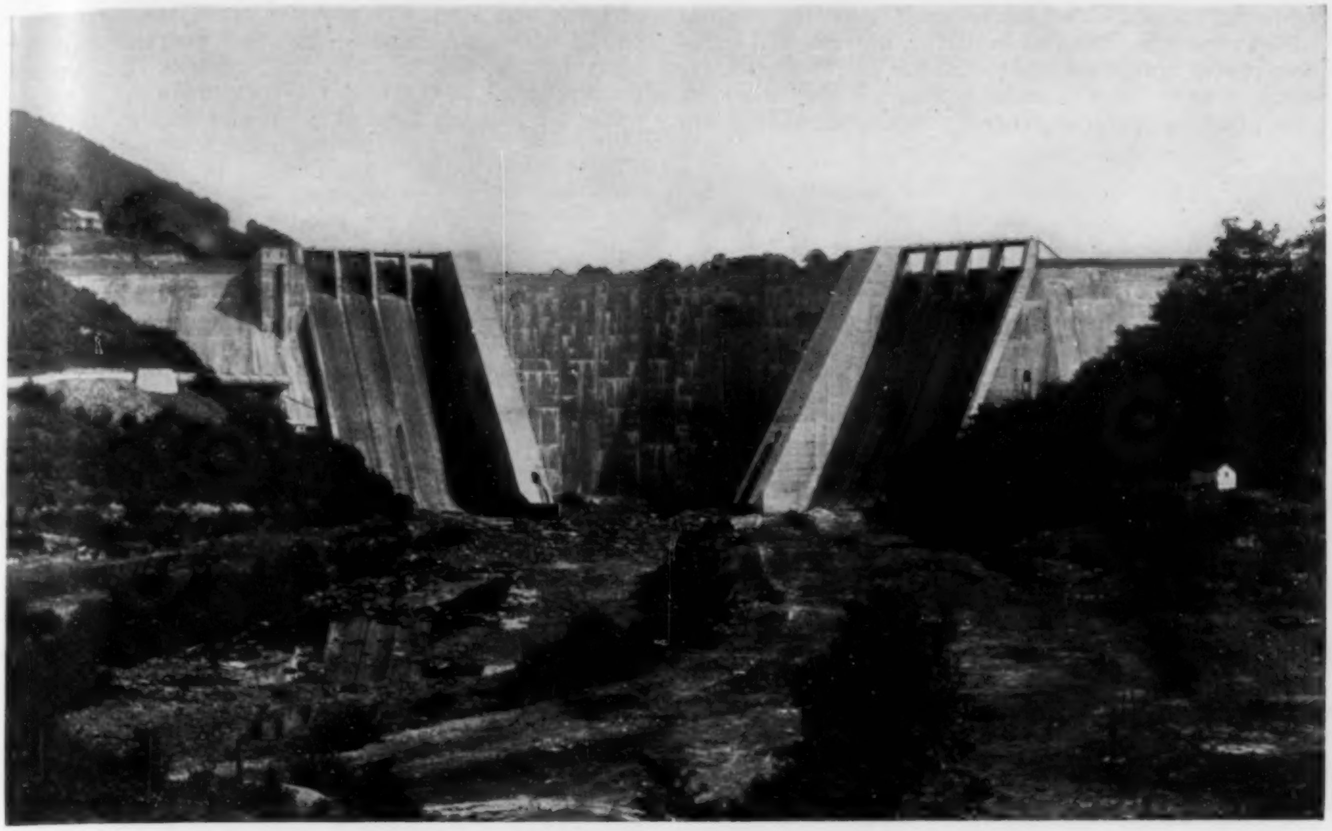


FIG. 2. DIAGRAMMATIC PROFILE OF ALUMINUM COMPANY'S HYDRO-ELECTRIC PLANTS

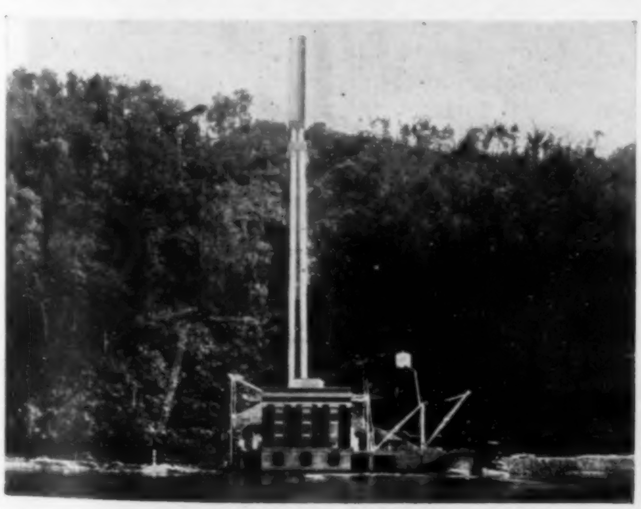


Santeetlah Arched Dam of Non-Overflow Type

ment lacks storage capacity to equalize the irregular flow of the river and when operated alone produces widely varying amounts of power.

SANTEETLAH POWER PLANT

Santeetlah, the second development, completed early in 1928, was intended to supply this needed storage. The dam is located across the Cheoah River, 10 miles above its mouth. It forms a reservoir having an area of 2,973 acres and a useful storage of 131,000 acre-ft, sufficient to provide annual regulation for the drainage area of 175 sq miles. The dam is concrete, 200 ft high and 1,150 ft long along the crest. The central section is a non-overflow arch 366 ft long, abutting on each side against a gravity section designed to take arch thrusts



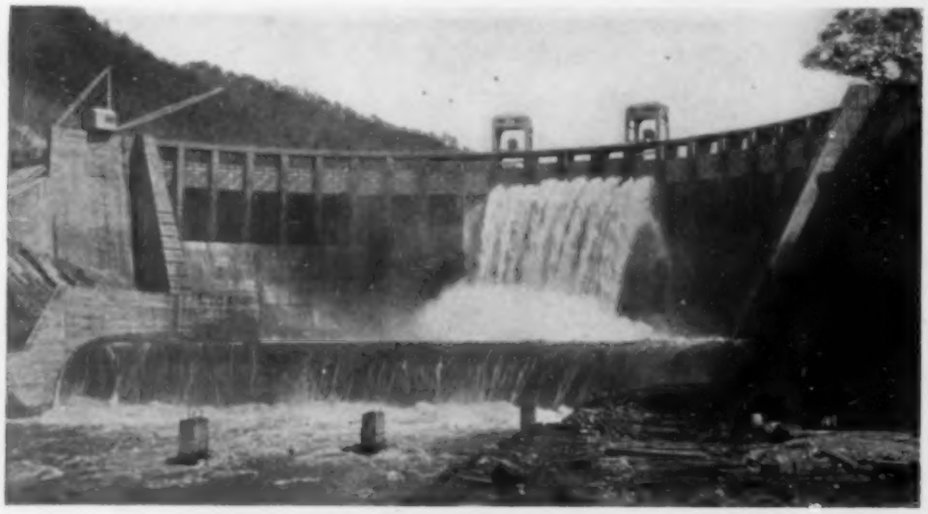
Santeetlah Surge Tank, Penstocks, and Power House

in addition to direct water load. Four Tainter gates, each 25 ft wide by 12 ft high, are located on each gravity abutment adjacent to the arch. They provide for a flood discharge of 40,000 cu ft per sec. The intake, with customary racks and gates, is located in the gravity section near the right bank.

The water is conducted from the dam to the surge tank through a five-mile pressure conduit operating under a maximum head of 160 ft. This conduit consists of a series of five separate tunnels having an aggregate length of four miles, connected by steel pipes 11 ft in diameter. The pipe is carried through the two shortest tunnels and well inside the portals of the other three. It is concreted solidly into the tunnels. The latter, except where the pipe projects into them, are horseshoe shaped, lined with concrete, and of an area equal to that of the pipe. The conduit ends in a Johnson differential surge tank, set on a hill 550 ft above the Little Tennessee River. The tank is of steel plate construction, 32 ft 6 in. in diameter and 163 ft high. It does not spill. Immediately below the surge tank the conduit divides into two branches, each protected by a remote-controlled, motor-operated Dow valve. Two steel penstocks 900 ft long, tapering from a diameter of 8 ft at the top to 7 ft at the bottom, extend from the valves down the 60-deg slope to the turbines. The penstocks are supported on steel-and-concrete saddles, anchored in rock and are exposed throughout.

The Santeetlah power house is located on the margin of the reservoir five miles above the Cheoah Dam. The substructure is of concrete and the superstructure of steel and brick. It contains two vertical units, each consisting of a 33,000-hp, 450-rpm, Francis-type turbine, taking 550 cu ft per sec of water under a maximum head of 660 ft. Each turbine is direct-connected to a 25,000-kva, 13,200-v, 3-phase, 60-cycle generator, with direct-

connected exciter. Two banks, each consisting of three 8,333-kva, single-phase, oil-insulated, water-cooled transformers step up the voltage to 150,000 v. The necessary switches and other station auxiliaries are provided. This plant is operated generally during periods of low water to fill out the valleys in the power curve not only by generating power locally but also by increasing the flow of the Little Tennessee River for use at the Cheoah and Calderwood plants.



CALDERWOOD DAM, DISCHARGING 8,200 CU FT PER SEC

CALDERWOOD POWER PLANT

Early in 1930 the Calderwood development was completed on the Little Tennessee River, 9 miles downstream from the Cheoah plant. The dam is a thin concrete arch, 230 ft high and 897 ft long along the crest. Twenty-four Stoney crest gates, each 25 ft wide by 20 ft high, provide a flood discharge capacity of 200,000 cu ft per sec. Flood waters fall into a cushion pool formed by a 40-ft auxiliary dam 300 ft below the main dam. The intake to the tunnel is in the ledge of the right abutment adjacent to the dam. It has removable steel trash racks and Stoney-type intake gates. The water from the dam is conducted to the power house through a pressure tunnel located in ledge rock. It has an arched roof, vertical sides, and a flat floor, and is lined with concrete to provide a smooth water passage. The upper 220 ft of the tunnel operates under a head of 41 ft, the remainder under a maximum head of 200 ft, and the two sections are connected by a 51-deg sloped shaft.

Turbine regulation is provided by a differential surge tank excavated in the ledge above the power house. The riser is concrete-lined, but the remainder of the surge tank is unlined. This tank is vented but does not spill. Just below the riser, the conduit divides into three branches into each of which a steel penstock 16 ft in diameter is concreted solidly. Each penstock may be closed at the upper end by a welded hemispherical emergency gate, which when not in use is stored in a recess in the rock immediately adjacent to the penstocks. The penstocks end in remote-controlled, hydraulically operated butterfly valves, 16 ft in diameter, which are located in a heavily reinforced concrete valve house set against the steep rock cliff.

The Calderwood power house is crowded into the narrow space between the river and the cliff. Its substructure is of reinforced concrete, and its superstructure of brick and steel. It provides space for three units, two of which are installed, together with the embedded parts for the third. Each unit consists of a vertical Francis-type, 56,000-hp, 150-rpm turbine, operating under a maximum head of 220 ft and taking 2,500 cu ft per sec under a normal operating head of 213 ft. Each turbine is direct-connected to a 45,000-kva, 3-phase, 60-cycle, 13,200-v generator, with direct-connected main and pilot exciters. Each unit is connected through oil and disconnecting switches directly to its bank of single-phase transformers, which in turn are connected through high-tension oil switches to the high tension bus. The bus may be sectionalized so that the station output can be sent out on one or both of the high-tension circuits.

TRANSMISSION LINE TWENTY-NINE MILES LONG

A double-circuit, 3-phase, 150-kv, neutrally grounded steel-tower transmission line 29 miles long connects the power plants to the substation at the Alcoa works. The 500,000-cm conductors are of aluminum cable, steel reinforced. They are supported by 10-unit strings of suspension insulators. In the very rough country adjacent to the power plants, the conductors of each circuit are arranged horizontally on a separate steel-tower line. In the relatively flat country adjacent to the Alcoa works both circuits are carried on a single tower line, with the conductors arranged vertically. A branch line connects each circuit to each of the power plants.

At the Alcoa substation, each circuit feeds into the opposite end of a sectionalized high-tension bus, to which are connected three banks of step-down transformers, which reduce the voltage to 13,200 v, for distribution to the various parts of the works. Each bank of transformers consists of three 14,000-kva, single-phase, oil-insulated, water-cooled transformers.

This hydro-electric system is designed to utilize, at an annual load factor of approximately 60 per cent, the entire flow of the Little Tennessee River, amounting to 4,500 cu ft per sec, when the available storage above the present plants has been developed. As built, it produces 120,000 kw-years of primary and high-grade secondary power, which is used in the reduction of aluminum from its ore and in the manufacture of various commercial forms of aluminum and aluminum alloys. Power is also interchanged with other power systems operating in the area.

PIONEERING WORK ACCOMPLISHED IN DESIGN AND CONSTRUCTION

Such a brief description of the three power plants can only give the general picture. Each plant has certain features of design or construction which at the time were new and in a sense pioneering. When constructed, Cheoah was the highest dam in the world over which large volumes of water must be passed. The tremendous amount of energy that had to be dissipated near the toe, and the damage sustained in the past by smaller structures, made it necessary to give the problem most careful attention. The theory of hydraulic models was carefully studied, and models were built

and tested. These pioneer studies and tests, undertaken in 1914, determined the significance of the hydraulic jump as a means of dissipating energy at the toe of a dam and showed that a certain depth of water was required below the dam for each flood flow to permit the development of a hydraulic jump and thus prevent erosion. A narrow channel below the dam increased the depth of water at the toe at a relatively rapid rate, so that the worst condition was encountered with a flood of 60,000 cu ft per sec. Experience and operation have confirmed the predictions based on the model studies.

The Calderwood site was perfectly suited to an arch dam. However, it was necessary to provide for passing a flood of 200,000 cu ft per sec. An ogee spillway would require a great deal more concrete than an arch, and the steep rock walls extending high above the crest made side spillways impractical. If the flood waters could be taken over the crest and permitted to fall freely, without contact with the dam, an economical design would be achieved. A study of natural waterfalls pointed to a deep pool as the correct way of stilling the water and absorbing its energy without damage to the river bed or the structure. This pool could be formed by a low auxiliary dam some distance below the main structure. Again models were made and tested. The investigations showed that the depth of the pool could be materially reduced by causing the jet of water to strike a U-shaped deflector at the bottom of the pool, thus doubling its effective depth. As built, the dam functions exactly as predicted by the model. The provisions for passing flood flows are so effective that loose material on the bottom of the pool has not been disturbed by a flood of 70,000 cu ft per sec, the largest that has occurred since the dam was built.

Calderwood Dam was the first structure of its type in which all the concrete was placed with the help of vibratory tampers. This method of compaction in the forms permitted the use of very dry concrete, which is not only impervious to water but has exceptional strength for the amount of cement used. This method of placing concrete has since been widely adopted.

The steep and rocky mountain side rises a thousand feet above the Calderwood power house, so that frost and heavy rains send rocks of all sizes thundering down the slope into the river. The power house and the transformers, switches, and valves were protected from falling rock by a V-shaped reinforced-concrete wall, firmly doweled to the rock of the mountain side. The wall was designed to deflect rather than to stop the rocks and debris. So far it has functioned perfectly.

Numerous other problems arose in connection with the design and construction of each of these plants. In many cases the solutions found were novel and interesting.

Development of power was undertaken by the Aluminum Company of America to supply power for its Alcoa aluminum works, which is located on a tract of 3,000 acres, adjacent to the town of Maryville, Tenn. It includes a reduction plant, a fabricating plant, and a town for workmen. For the reduction of aluminum oxide to metallic aluminum, the plant is provided with ten electric furnace rooms, commonly known as pot rooms. Direct current for use in the reduction process is supplied by two synchronous converter stations with a total installed capacity of approximately 100,000 kw at 500 v. Carbon electrodes, which are consumed in large quantities in the reduction process, are produced in an electrode plant adjacent to the pot rooms.

The pig aluminum produced at the reduction plant is transported to the fabricating plant, where it is remelted and cast into ingots for further fabrication. The principal fabricating operations carried on at Alcoa are the rolling of sheet and plate and the manufacture of aluminum bronze powder.

Many Uses for Aluminum

It may not be amiss in this connection to mention some of the newer uses for aluminum of interest to

Calderwood Power House Showing Deflecting Concrete Wall

engineers. First there are the stream-lined trains, which have been breaking all records within the past few months. Some of these are built chiefly of aluminum alloy, much of which comes from Alcoa. Whether or not aluminum will ultimately dominate the stream-lined field in railroad transportation, it is certain that the light weight and high strength of its alloys will give them a prominent place in this field. The metal has also been used successfully for locomotive side rods, hopper cars, tank cars, and passenger cars. Trucks, buses, and street cars are likewise made of aluminum alloys, while the modern airplane is fashioned almost entirely from this light-weight material.

In construction plant equipment there is also an opportunity to reduce weight and increase capacity by substituting aluminum for heavier materials. Examples are seen in booms and buckets for drag-lines, in cranes and hoists—in fact, in every type of equipment where increased capacity and reduced dead load can be made to pay dividends.

One of the most interesting recent uses of structural aluminum has been in the reconstruction of the old Smithfield Street bridge across the Monongahela River in Pittsburgh, which was described by Messrs. Riegel, Templin, and Growdon in the March 1934 issue of Civil Engineering. In this case the reduction of dead load effected by the use of this metal permitted the structure to safely carry live loads in excess of those for which it was designed, thus greatly prolonging its useful life. In other cases the substitution of a light-weight aluminum deck for a heavier one will make it possible to increase the width of the bridge and double the number of traffic lanes without increasing the stresses in the supporting structure.

The hydro-electric power system of the Aluminum Company of America has been designed and built under the direction of James W. Rickey, M. Am. Soc. C.E., chief hydraulic engineer, and under the general supervision of Edwin S. Fickes, M. Am. Soc. C.E., vice-president and chief engineer of the company.

Coordinating Automobile and Highway Design

Engineering Cooperation Badly Needed in Attacking Problem of National Safety

By John W. Wheeler

Member American Society of Civil Engineers
Member, Indiana State Highway Commission, Indianapolis, Ind.

As automobile manufacturers continue to build faster and faster cars, hard-surfaced roads tend to become obsolete while still in excellent condition structurally. One attempted solution is to construct highways adaptable to unrestricted speeds. In Oregon, for example, main roads are being located and designed for speeds of from 90 to 100 miles per hour. But the resultant cost of widening rights of way and providing greater sight distances through the elimination of sharp curves and grades is elsewhere considered prohibitive, and in Indiana the problem is being approached from a different angle. This article, which was prepared from Mr. Wheeler's address delivered in November 1934, before the American Association of State Highway Officials, presents some practical arguments in favor of placing a definite physical limit on the speed of automobiles so as to avoid the present rapid obsolescence of roads and, at the same time, reduce today's staggering highway accident rates.

During the year 1933, automobile accidents in the United States resulted in the death of 29,900 persons and the injury of 850,700 others, and occasioned an economic loss of approximately $2,000,000. In the last ten years, 273,112 persons were killed by automobiles. The average number of murders per year is 11,500; the average number of deaths by automobile, 30,000. Most of these deaths occur in the country, in the daytime, on dry pavements, and where the road is straight. The major conflicts in which the United States has participated—namely, the Revolutionary War, the War of 1812, the Mexican War, the Spanish-American War, and the World War—have occupied a total period of 15 years of hostilities and resulted in the deaths of 300,000 American soldiers; automobile traffic accidents during the last fifteen years have been responsible for the deaths of 325,000 Americans.

Such facts are vouched for by a number of reputable authorities and are commonly accepted as a fair appraisal of relationships. Furthermore, such statistics no longer startle us; rather we have come more or less to accept them. One more fact will suffice to indicate what is perhaps the greatest proximate cause of all this useless slaughter. At 20 miles per hour a car can stop within 38 ft; at 60 miles per hour, a distance of 263 ft will be required to bring it to a stop.

Nations have met in conferences in all parts of the world to abolish war, with more or less success. Millions have been spent in these attempts, yet a condition of danger to life and property existing here in America is as bad as war. The handling of this problem may be difficult but it can be corrected. Highway and bridge plans that are on drafting boards today will in all probability be obsolete by the time the road or bridge is finished. This is a bold statement, but it has proved true in the past. If the builder of railway equipment and the builder of railway tracks should refuse to confide in each other on the design of equipment and track, would they not be condemned as foolish? The engineers who designed the recently built streamlined trains knew exactly what degree of curvature and what gradients the trains would run over. They knew the weight of the rail, the kind of ties, and the nature of the ballast. The automotive engineer, on the other hand, does not know what the road designer is building. Nor does he know anything about the curves, grades, or widths. Conversely, the highway engineer has no notion of what the automotive engineer is designing for his 1935 model. He does not know what its maximum speed, or its advertised cruising speed, may be, or whether it is to be more streamlined or less, or whether its center of gravity is to be lowered or raised.

This anomaly is due in part to the fact that the automotive engineer works for private industry and is paid in proportion to his ability. By that I mean that if he is inventive enough to bring out drastic improvements in automotive design, he will be rewarded greatly in pay for his services. He is anxious therefore to design and build progressively faster automobiles. The highway engineer, however, works for some political body—state, county, or city—in which the reward for work is generally controlled by statute and changes

Typical Example of Short Sight Distance Due to a Sharp Vertical Curve

Horizontal Curve on a Concrete Road, Conducive to High Speeds, Presents Traffic Hazard

very seldom. As a result of this he has little incentive to make drastic changes in highway design, and if he did make changes, they would probably be frowned on by the taxpayers as being elaborate and unnecessary. And so today the automotive engineer is in the vanguard as far as design is concerned, and the highway engineer is struggling manfully to keep up.

Recently in discussing this question with two officials of a large automobile company, I stated that I understood their 1934 model had a maximum speed of 100 miles an hour, and that they advertised a cruising speed of 80 miles an hour. They answered that this was true and that, furthermore, their 1935 car as designed had a maximum speed of 120 miles an hour and an advertised cruising speed of 100 miles an hour. The State of Indiana bought one of these new-type cars. Thus from actual experience I can say that the highway of yesterday is unfit for the motor car of today.

Plans for an important state highway built by the Indiana State Highway Commission in 1924 provided for curves up to 30 deg and grades up to 7 per cent, which meant very limited visibility. Such a design was suitable in 1924 because the average speed was 30 miles an hour on the highway. Plans for a road built by the commission in 1931 provided for 10-deg curves and 7 per cent grades. These limits were suitable in 1931 because the average speed was 40 miles an hour. Both of these pavements are still in excellent shape structurally, but hazardous because the rolling stock has changed. From 15 to 20 years of service remains in these roads, but death stalks on them today. The commission is now rebuilding the former highway to eliminate bad curves, short sight distances, and narrow structures, and is also widening the roadway. It is thus actually tearing out concrete pavement that is still structurally fit for years of service.

HIGH-POWERED AUTOMOBILES INDUCE EXCESSIVE SPEEDS REGARDLESS OF CONTROL MEASURES

My point is that no matter how many conferences we hold, no matter how loud we lament traffic accidents, no matter how drastic we make traffic rules and regulations, no matter how many highway policemen we appoint, as long as the automotive designer makes a speed of 120 miles an hour possible, the boys and girls of today will sometimes get 120 miles out of the car, and some of their fathers and mothers will do the same.

It may be asked why we do not super-elevate our curves to correspond with higher speeds. There is a limit to which this can be done. At the speed for which the super-elevation is designed, it will counteract the centrifugal force generated in rounding the curve, but on a winter morning when the curves are slippery and speed is decreased, the law of gravity tends to slide cars to the inside of the curve. Therefore, there is a limit to super-elevation of curves.

COST OF ROAD IMPROVEMENT AN IMPORTANT FACTOR

Another question frequently asked is, why roads are not built wider and grades eliminated. Excessive cost is the answer. It might be profitable to discuss the value of our time and see if it is economically necessary to increase average speeds above, say, 45 miles per hour. Is it the doctor who drives at terrific speed on calls, or the fire engine on its runs? Perhaps it is, but it is just as apt to be someone going to a motion picture show, hoping to get there at the beginning of the picture instead of in the middle of it.

RESULTS OF EXCESSIVE SPEED ON A MODERN HIGHWAY
20.2 Per Cent of Indiana Accidents Are Due to Vehicles Striking Fixed Objects

A most pertinent question naturally arises—is there no limit to which we can build; is there not some speed per hour that is sufficient? To me, the heart of the whole problem is to find a speed that both the highway engineer and the automotive engineer can decide upon as sufficient, and then both build for that speed. Let the automotive engineer build a better car that will have a speed of a certain number of miles per hour, and let the highway engineer design the perfect road, or as near the perfect road as is possible, for that number of miles an hour, and then let both stick to that limitation. This question is all important to a state highway official because his responsibility does not end the day the road is accepted; rather he is partially responsible for accidents on the highway and so this is his first order of business. On the Indiana state highway system about 600 persons are killed each year, in addition to many who are seriously injured, with consequent great property damage.

Speed predominates among the factors that go to make up an accident on the highway. Records of the traffic engineer of the State of Indiana for an average year showed that 20.2 per cent of the accidents came from vehicles striking fixed objects, such as bridges, utility poles, and ditch banks. In these cases speed certainly plays its part. During the same year 47.9 per cent of the accidents came from vehicles striking other vehicles, and in these collisions again the matter of speed was all-important.

There is a very definite line of demarcation between the speed at which a car can be controlled, and the next higher bracket of speed, at which the driver is practically helpless when a crisis arises. The speed of an automobile can only be regulated in its design on the drafting board. Until a maximum speed is set, and the automobile is designed and the highway is built for that speed, American death and accident records will increase in spite of all that highway engineers can do to prevent it.

Research as Applied to Engineering

Its Importance in Industry and Economics Stressed

By Earle B. Norris

Dean of Engineering, Virginia Polytechnic Institute, Blacksburg, Va.

Out beyond the frontiers of engineering knowledge are the research workers, seeking by the best scientific route the goal of new processes, improved products, and rational control of materials and markets. The research engineer has followed so closely upon the heels of the scientist that he has in some cases even replaced the latter. Research is not impractical; the history of the rise of many leading American industries has been the history of their accomplishments in research. These and similar statements, made by Dean Norris in the following article, are backed up with figures showing that research is valuable not only from a scientific viewpoint in developing new data, but also in a materialistic sense by furthering material progress and bringing in large financial returns. This article was originally presented at a meeting of the Virginia Section of the Society on November 9, 1934.

To the layman, the professional engineer is typified by the motion picture type, invariably portrayed as a handsome, stalwart fellow in field boots, corduroy breeches, flannel shirt, and broad brimmed hat. Usually he is the hero of the piece, while the villain is the unscrupulous financial promoter. To the same lay mind, research is typified by a bespectacled gentleman with a high forehead, garbed in a white smock and pictured either holding a test tube to the light or else peering intently through a microscope.

Both pictures are completely inadequate. The microscope and the test tube are no more parts of all research than are the field boots and wide felt hat necessary items of apparel of every professional engineer; and yet most people are prone to regard research with exactly this false concept in mind.

In pioneer days in this country there were scouts—Boone, Lewis and Clark, Carson, Cody, and Bridger—exploring the unknown areas of the continent. These were followed by the pioneers, who settled the country, cut the timber, and put the soil under the plow. So today the research workers in pure science may be considered as scouts, whose sphere of activity is beyond the frontiers of knowledge, while the engineers may be considered to be the pioneers, adapting this newly acquired knowledge to the uses of mankind.

As science advances so must engineering advance. In fact, so closely does engineering follow pure science that it is difficult, if not impossible, at times, to draw a line of demarcation between them. In this connection Faraday's classical retort may be quoted. When a high government official in England asked him of what use was his discovery of electrical induction when a wire was moved through a magnetic field, he replied, "Some day you will tax it." Fifty or more years later engineers had evolved the electric generator from Faraday's discovery. Today the truth of Faraday's prediction can be easily verified by asking any official of an electric service corporation about its taxes.

It took mankind 6,000 years to progress from the pine torch and tallow dip to the kerosene lamp, but only about fifty years from the kerosene lamp to the incandescent electric lamp. Within the past twenty years new types of electric lamps have followed one another in rapid succession. Pure science used to be considered as a thing apart, the developments of which were theoretical abstractions of little if any possible practical value. Now engineering developments follow so closely after scientific advances that each new discovery is seized upon and converted within the space of a few months into something for mankind to enjoy.

There is no longer a gap or even a line of demarcation between science and engineering. The scientist is pretty much of an engineer and the engineer must be a fair sort of scientist. The scientist, to use the motion picture concept, is generally able to don the field boots and flannel shirt, while the engineer is equally expert with the test tube and microscope. Frequently it is hard to know what label to apply to some men. In which group would we put men like Irving Langmuir and Willis R. Whitney, of the General Electric Company; Sergius P. Grace, of the Bell Telephone Laboratories; A. Nadai of Westinghouse; or Elmer A. Sperry? Scientists truly, but also men who understand the applications of their scientific studies. Engineering is supposed to be applied science, taking the science developed by others and applying it to practical purposes. Why then have the engineers extended their activities into the realm of pure science? Because in many fields they have caught up with the scientists and have been forced themselves to become scouts in the vanguard of knowledge. It has become rather common, in recent years, for a need or demand to arise in such a way that the engineers representing industry have gone out into

Steel Wind-Stress Model Under Test at Ohio State University Engineering Experiment Station

The Lower 13 Stories of a 55-Story Wind Bent Were Simulated by a Spot-Welded Steel Model Which Lay Flat on a Table and Was Anchored at the Base to a Concrete Pier. Wind Loading Was Applied at Each Story by the Small Dead Weights Shown, Plus a Larger 315-Lb Weight Representing the Force of the Wind on the Upper 42 Stories, Not Constructed. The Pin-Connected Test Rigging Was Specially Designed to Deliver Design Shears and Direct Stresses at Thirteenth Story.

uncharted territory, making their own trails. The Michelsons and Einsteins and Morleys of pure science are too few in number to take the particular increments which each makes to human knowledge and fit them together into a perfect pattern which they can hand over to the engineers and say, "Here it is; now see what use you can make of it."

The research engineer is the reconnaisance party of industry, generally seeking the best route to some definite goal. Often, however, he will come on attractive trails leading elsewhere and return with tales of new and unexplored territory.

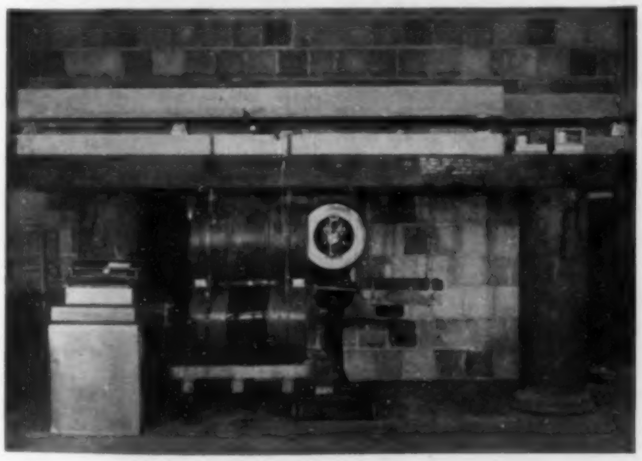
With this change in the demands made on the engineer has come gradually but surely a changed conception of his proper training. No longer is the aim only to train technicians. The days when shop and field practice held a dominant place in engineering training are past. These courses are planned solely to make the student understand his theoretical courses. The aim is, or should be, to train scientists with some appreciation of the human need for science.

RESEARCH IN INDUSTRY

Research is only the accumulation of more facts or the application of those already known to the uses of every-day life. An official publication of the Glass Container Association states in part that "Research in industry is and should be nothing more or less than an intelligent inquiry into how to do practical things; if they are new, how they can be done in the best way; if they are old, how in a better way. In a word it is invention. Research is not impractical. It is the most practical thing in the world for individual business firms or organized businesses to engage in."

Research is one of the best forms of insurance for capital invested in industry. There is a direct relationship between the rating of the securities of American industries and the rating of their research activities.

It seems obvious that such products of scientific research as the automobile, motion pictures, and radio have deferred the crisis and given work to millions who otherwise would have been unemployed years ago.



MAKING "CONSTANT DEFLECTION" TESTS ON A CONCRETE BEAM

Apparatus Used at Ohio State University Engineering Experiment Station to Secure Data on Release of Stress That May Occur in Continuous Concrete Structures Due to Plastic Flow or Time Yield. The Lower Concrete Beam Shown Was Maintained at a Constant Deflection for 28 Days by Progressively Reducing the Live (Water) Load. The Upper Beam Was Identical with the Lower and Enabled Separation of the Dead-Load Deflection from the Total Merely by Manipulation of the Water Valve So That the Distance Between the Beams Remained Constant

There are many causes contributing to the years of depression through which we have been passing—unscientific banking, an unscientific social and economic structure, and, not least, the lack of adequate research and invention in the industrial world. There has been too much mechanization of industry without the development of new industries to give employment to the available labor, too much imitative competition and not enough originality. The productive capacity for a few things has been greatly over-expanded, resulting in ruinous competition and idle plant capacity. Unrestrained competition spells disaster. Much of our excess plant capacity must be converted into plants for the manufacture of new, original conceptions of scientifically directed research talent. There are too many industries that are trying to operate under the traditions of the past or to scrape along by copying the methods and developments of their more successful competitors.

TESTING ARTIFICIAL STREAM-CONTROL WEIR, NATIONAL HYDRAULICS LABORATORY

These Wiers Are Used to Establish a Definite Cross Section in Streams at Gaging Stations

It is frequently stated that some new invention is needed to lead us out of the depression. But can we wait for some single discovery to spring from a single brain? It may take a hundred inventions or a thousand. The responsibility rests not on a single industry, but on the whole aggregate of American commercial enterprise.

A recent poll of one thousand businesses gave as the leaders of the New York Stock Exchange the following industries: American Telephone and Telegraph, U. S. Steel, General Electric, Standard Oil of New Jersey, General Motors, Anaconda Copper, Radio Corporation, and Westinghouse. A list of "who's who in research" would contain these same names at or near the top. These companies have not been content to trail along, copying the products and methods of others. Rather they have employed scientifically trained men with vision to keep them in the vanguard of progress. Within a lifetime some of these and other industrial giants have grown from small beginnings to their present proportions because they have constantly used science for the betterment of their products, the elimination of waste, the extension of markets, and the development of new products. What these giants did in the years of their infancy almost any small industry of today can repeat with equal chances of success.

There is nothing new in the idea of research as a

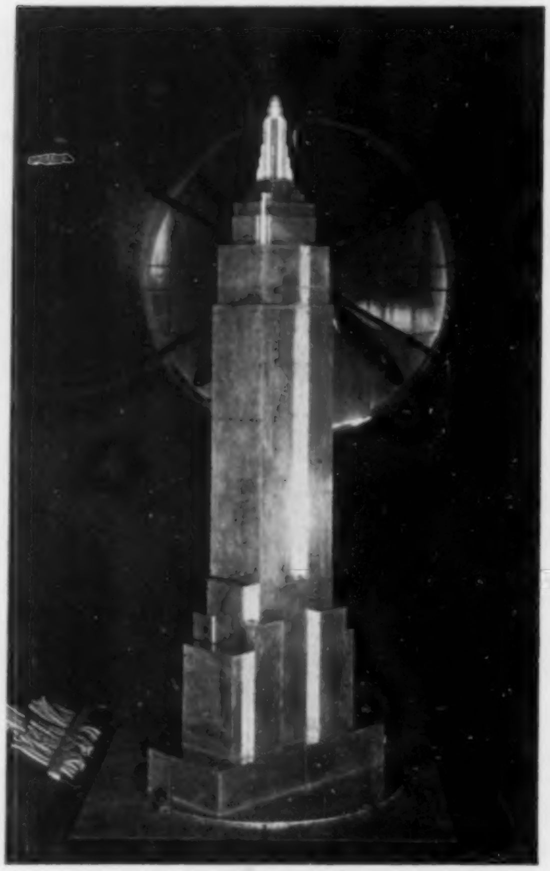
method of attacking a problem. In one guise or another research always has and always will exist so long as mankind continues to make scientific and material progress. More is heard about research at the present time only because there is a more extensive fund of exact scientific knowledge that can be applied to the solution of practical problems. Hence, there has necessarily been developed a technic and a corps of men trained in the procedure of applying known facts to particular problems. Industrial research departments represent merely a functional segregation of this activity. Stagnation is the easiest thing in the world. The best means of guarding against it is a definite research organization.

Scientific research is merely straight thinking, but thinking based on facts, not on hunches or guesses. Research in many cases may not make any use of test tubes, retorts, or microscopes, but nevertheless it applies the scientific method, the laboratory procedure, to the solution of specific problems. The final solution comes from someone's head, not from a piece of apparatus.

The research department should be considered and treated as a self-sustaining, operating department. When the U. S. Ordnance Department established its X-ray laboratory at Watertown Arsenal, it was for the purpose of inspecting steel castings for soundness. In the first few months of operation the steel foundry staff learned so much about such matters as moulding practice and proper gating from this X-ray inspection that the steel foundry was able to take over the operating cost of the X-ray laboratory as a part of its current operating expenses and still reduce costs.

It is all too easy for a manager or a board of directors to say that they have no research problems and hence no need of a research organization. Often a plant is full of problems wholly unknown to the management. Before du Pont and General Motors attacked the problem of finishing automobile bodies more quickly, Charles F. Kettering tells us that it took 17 days to finish the cheapest car bodies and 37 days for the expensive ones. Imagine a body works turning out 1,000 bodies a day and having to provide working space for 17,000 in the finishing rooms! Surely that was a problem. And yet it took men of vision, men who were not satisfied with older types of paints and varnishes, to realize that it was a problem capable of solution. Now five coats can be applied in less than one hour. Hundreds of industries had used the older painting processes for years without ever realizing that they could be improved. It frequently takes more vision and imagination to recognize such a problem than to solve it.

Often it is the man who knows nothing about the traditional operation of an industry who will see opportunities for improvement that have been overlooked by others, equally equipped mentally, who have long been accustomed to the traditional practices. Thus research requires a man not only free from tradition, but one wholly free from the routine duties of management. Hence research should have its own staff. Industry cannot depend for the solution of its problems on men who have other duties of a routine nature.



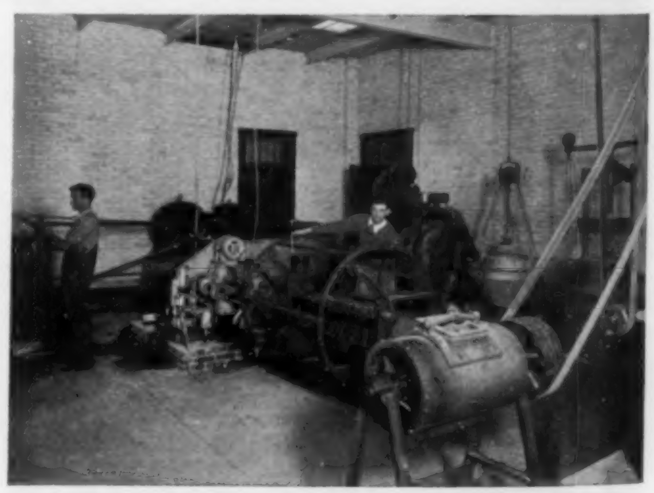
STUDYING DISTRIBUTION OF WIND PRESSURE ON A MODEL OF THE EMPIRE STATE BUILDING IN THE BUREAU OF STANDARDS, U. S. DEPARTMENT OF COMMERCE

After long experience Mr. Kettering advocates that research should be considered as a self-sustaining, operating department. One firm, Leeds and Northrup of Philadelphia, has a plan of accounting for its research department which determines costs and assigns credits to that department for every new product or process developed.

If a new device is produced, a committee decides on a royalty to be credited to the research department just as if some outside inventor had brought the device to them. For the first four years of operation the research department was "in the red." At the end of the fifth year it broke even, and during the next twelve years the cumulative credits exceeded the cumulative expenses by half a million dollars.

In 1921 Charles L. Reese, of du Pont, made the statement that the company's total expenditure for research for the seven years 1912–1918, inclusive, had been $6,051,000 and that the calculable saving, disregarding those many benefits which could not be figured in dollars and cents, had been $82,401,000.

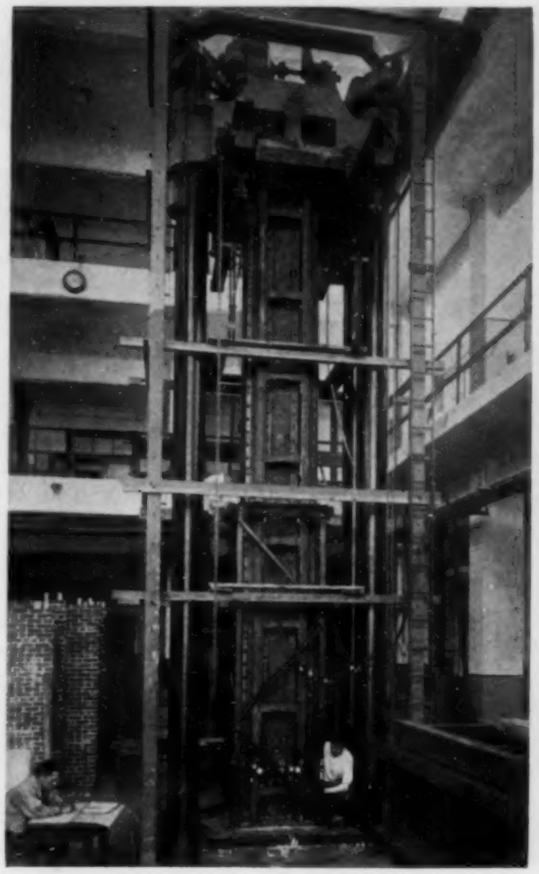
Research is not, as many think, an expensive hobby that can be indulged in only by billion-dollar corporations. Some of the best industrial research on record has been carried out under the auspices of trade associations made up of a number of comparatively small industries. Every American citizen has profited by



HEAVY CLAY PRODUCTS LABORATORY AT THE VIRGINIA POLYTECHNIC INSTITUTE

results of research supported by the Laundryowners' National Association and by the American Bakers' Association. The National Canners' Association spends the greater part of its income on research, knowing full well that better and more uniform canned goods and more varieties make for greater markets and more certain profits for all the canners. The cost to each is comparatively small, based on the number of cases of products packed by him, but the results are available to all alike. Some of the problems investigated may be of interest. Among them are a study of tin plate to determine its suitability as a container for certain foods; the causes and elimination of discoloration in certain foods; proper processing time and temperature; the effect of the composition of water in the preparation of canned foods; better seed varieties and better seed supplies for canners' crops.

In recent years competition has often been more keen among different industries than among units of the same industry. Foundries as a group must face competition from pressed metal and electric welding; fuel oil competes with coal; glass and tin plate compete for the food container business; lumber, steel, concrete, and brick compete as building materials; the railroads are less concerned over competition among themselves than over that from motor transportation. Consequently trade association research to improve the products of all units of an industry, to develop new markets and new uses, to secure greater uniformity of product, has become of paramount importance. The latest available statistics show at least 100 trade associations which have recognized that research for the benefit of their members is a definite responsibility.



TEN-MILLION-POUND TESTING MACHINE OPERATED BY HYDRAULIC CYLINDER

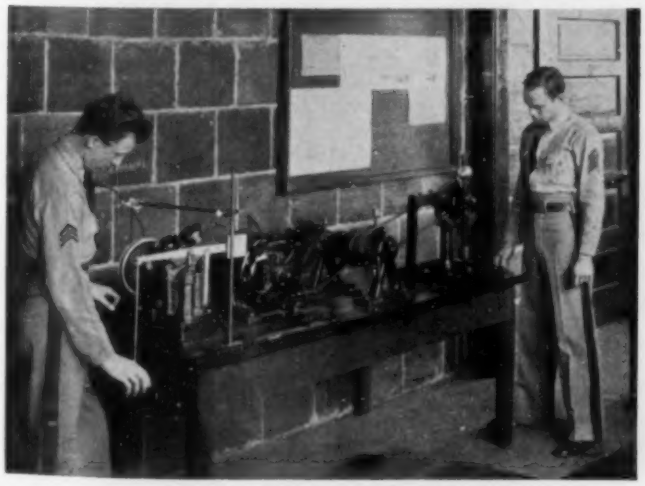
Compressing Half-Scale Model of Steel Column for the George Washington Bridge at the Bureau of Standards

In some cases such research constitutes the chief activity, and the annual expenditures of certain associations for it run into hundreds of thousands of dollars.

In 1920 a survey by the National Research Council showed 575 research laboratories maintained either by single industries or by trade associations. By 1927 this list had grown to over 1,000, and in 1931 it was reported as being over 1,600. During the depression years many industries expanded their research activities in a search for new products and new uses for existing products.

The National Industrial Recovery Act resulted in the formation of hundreds of trade associations in which industries joined together for their common welfare. These code organizations have offered an excellent basis for starting industrial research for the benefit of each group.

A number of associations, such as the baking industry, the portland cement industry, and the copper and brass industry, have equipped and maintain their own laboratories. This usually requires a large initial outlay. Others avail themselves of the facilities offered by the Mellon Institute, the Battelle Memorial Institute, or the many excellent commercial consulting laboratories. In some cases the facilities of different government laboratories, such as the Bureau of Standards, the Bureau of Mines, and the Forest Products Laboratory, can be utilized. In many cases arrangements have been made with technical colleges and universities, where a large corps of specialists and extensive laboratory facilities are already available.



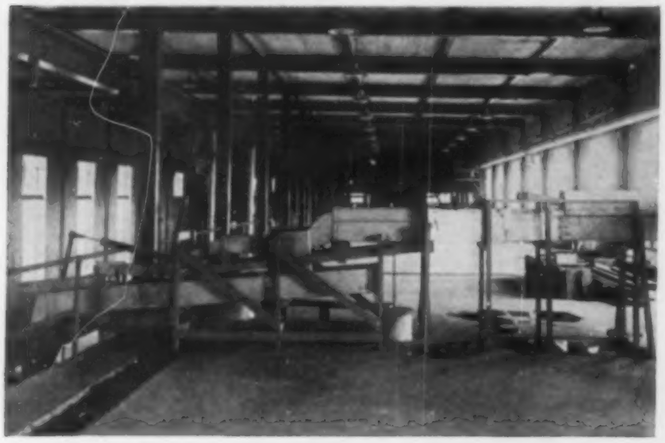
A CORNER IN THE LUBRICATION LABORATORY, VIRGINIA POLYTECHNIC INSTITUTE

INDUSTRIAL RESEARCH IN THE COLLEGES

It has been estimated that up to the present century fully three-fourths of the fundamental discoveries on which great industries have been built came from college and university laboratories. Watt, at the University of Glasgow, laid the foundations for steam engineering. Professors Morse, of New York University, and Henry, of Princeton, laid the foundation for the telegraphic systems. Professor Faraday, at the Royal Institute of Great Britain, and Prof. Clerk Maxwell, at Cambridge University, developed the fundamental theories on which the whole electrical industry is based, while in the United States the General Electric Company grew from the efforts of Prof. Elihu Thomson, of the Massachusetts Institute of Technology. The Bell Telephone system originated in the work of Prof. Alexander Graham Bell, of Boston University; Gibbs, at Yale, laid the whole foundation for physical chemistry; and the aluminum industry was started by Prof. Charles M. Hall, of Oberlin College. More recently Professor Pupin, of Columbia, made long-distance telephony possible with his loading coil, and Professor Baekeland,

also of Columbia, created the synthetic resins known as "bakelite." Professor Sweeney, at Iowa State, is creating a whole group of industries based on the utilization of corn stalks and corncobs. A long list of industries pay royalties to the University of Wisconsin for the use of the Steenbock process for irradiated foods.

Industry and pure science work so closely together that the modern industrial executive and the college scientist can meet and talk in terms of common understanding. The industrial executive must be as technical as the college professor, while the professor's work is so closely allied to industrial problems that he could be,



APPARATUS FOR STUDYING PERFORMANCE OF DIVISORS Used in Sampling Run-off from Test Plots in Soil Erosion Surveys. National Hydraulics Laboratory

and sometimes is, a technical executive of industry. In fact, the laboratories and engineering offices of many industries contain a large quota of ex-college professors.

The stronger technical colleges have their staffs of specialists in every field of scientific knowledge. It is but logical, then, that a great many industries and trade associations have found it desirable to utilize the research facilities of some technical college rather than establish their own at heavy expense. In fact, most of the trade associations have begun their research work in cooperation with some college laboratory. Some have outgrown the college facilities and have built their own laboratories, while others have continued their original connection. The Portland Cement Association developed its research program at Lewis Institute, but now has its own staff and facilities; the American Bakers' Association began its work in cooperation with the Mellon Institute at the University of Pittsburgh, but now has its own laboratories. On the other hand, the Bottlers of Carbonated Beverages maintain fellowships at Iowa State College; the American Gas Association supports projects at several universities; the Common Brick Manufacturers Association has cooperated with the Virginia Polytechnic Institute and other technical colleges. The Leather Belting Exchange has its research done at Cornell University; the Tanners' Council of America, at the University of Cincinnati; and the Warm Air Heating and Ventilating Association, at the University of Illinois. These are but a few of numerous cases that might be cited. Single industries even more than associations take their technical problems to college laboratories. The cost is much less than that of attempting to set up all the equipment and staff of specialists otherwise necessary.

It should perhaps be emphasized that technical research is not necessarily restricted to the fields of chemistry, physics, and the various better-known branches of engineering. There are many phases of management that can be and are effectively studied as research projects—problems of industrial organization, studies of various possible methods and channels of marketing or distribution, methods and types of advertising, costs and cost-accounting systems, economic lot sizing in manufacturing, economic replacement of manufacturing equipment, depreciation and absolescence policies.

In forty of the state colleges and universities of America, including Virginia Polytechnic Institute, engineering experiment stations have been set up, making the advance of scientific knowledge as applied to engineering and industry a definite function of those institutions. Most engineers know of some of the work done at the pioneer engineering experiment station at the University of Illinois. The contributions of Moor on fatigue of metals, of Talbot on concrete, and of Willard on warm-air heating are well known. In thirty years the state of Illinois has spent about $1,500,000 in this station, while the economic returns to industry have recently been estimated at $87,000,000.

It may be of interest to mention specifically what has been done at Virginia Polytechnic Institute. About three years ago, a study of the casting properties of type metals was started. It was traditionally believed that type metals expanded as they "froze" from the liquid to the solid state and that this expansion was what gave the perfect face to the type. It was found, however, that this theory was wrong, that type metals did not expand on "freezing." By studying the surface tension in the liquid phase it was discovered that low surface tension is necessary to a good type face. Then the effect of various constituents on the surface tension was studied. Among other things it was found that zinc, even in very small quantities, was decidedly detrimental and that a small addition of sodium materially reduced surface tension. What was this discovery worth? The president of one large type foundry said that he would have been willing to pay $10,000 if he could have had three months advance information on it. The bulletin of the Virginia Polytechnic Institute on gear-train design is used as the last word on this subject by the manufacturers of Lincoln, Cadillac, and Chrysler automobiles, and by General Electric and other firms.

Just recently the Institute published a bulletin on the production of fuel gas in the process of sewage disposal. It had been known that a gas comparable with ordinary city gas was evolved in the digestion process. The Institute found that cellulosic wastes, such as old newspapers and magazines, leaf waste, and even peanut hulls, could likewise be digested with the sewage and would increase the gas yield as much as 25 per cent. The bulletin of the Institute, by Professor Sette, giving the results of his limnological study of the Pulaski Reservoir is used in several colleges as a textbook in that field of study. Some work at the Institute on the use of deflocculants with clay shows that the shrinkage cracks in drying and firing brick and clay tile can be reduced while at the same time the physical properties are improved. This work is being continued at present under a subsidy from one of the industries and is already in semi-commercial use.

Engineers are materialists in the sense that they are concerned with the material well-being of the race. And cultural advancement can come only after this has been established. Nor can art prosper unless the race can support its artists. Engineers believe that technical advancement through research is necessary to material prosperity and that without it the people cannot expect a well-rounded life.

Some Experiments on Laminated Dam Models

A Study of the Effect of Dividing Arched Dams Into Thin Shells

By John Hedberg

Junior, American Society of Civil Engineers

Junior Engineer, U. S. Bureau of Reclamation, Denver, Colo.

Experiments of any nature rarely give entirely consistent results, yet by and large experiments on models form an important part of much design work. A study made by Dr. Hedberg of the behavior of dam models with vertical laminations as compared with those of monolithic construction, while not directly conclusive, nevertheless is of much interest. Working with models of rubber composition, without lubrication between the parts, the laminated specimens showed less deflection at points of maximum stress and more deflection at points of minimum stress than the solid specimens. Plaster of paris models with graphite between the parts were used in a second series of tests in which further indications of relative displacements were sought. Results showed that under heavy concentrated shearing stresses some adjustments of the laminas do take place.

A few years ago there was some discussion among engineers over the merits of a design for arched dams that involved division of the structure into a series of thin shells separated by a lubricating material which would transmit normal loads but permit tangential displacements. This design was a logical modification of the original idea of dividing an arched dam into a series of independently acting thin shells, as illustrated by the Dordogne River Dam at Marège, France.

However, the bringing together of the shells and the forcing of them into consistent deformations involved complexities of action that made it difficult to anticipate stresses. Much of the difference of opinion concerning the desirability of lamination was due to the various conceptions of just how such a structure would react when a load was applied to it.

On one hand, it seemed as though lamination should produce real benefits. Certainly the division of the section of a cantilever beam greatly increases its flexibility. At the same time the division of a thick arch under water load into a series of thin ones, not only does not increase the flexibility very much but should produce a more uniform distribution of stress. Now, if the two effects should take place simultaneously, one would expect that part of the load previously carried by the cantilevers would be transferred to the arches. The result would be that danger of tensile stresses in the upstream face of the cantilevers would be relieved. At the same time, the increased loading of the arches would be more than offset by better stress distribution.

On the other hand, it might easily happen that the structure would be weakened by laminating, or at least not benefited. It is entirely possible that under certain conditions of laminating, concentrations of loading might be produced. Furthermore, it is probable that the resistance of the structure to shear would be impaired. However, the most serious objection is the probability that sufficient friction would be developed along the surfaces of contact to prevent the desired adjustment of stresses. If that should happen, the extra expense of laminat-

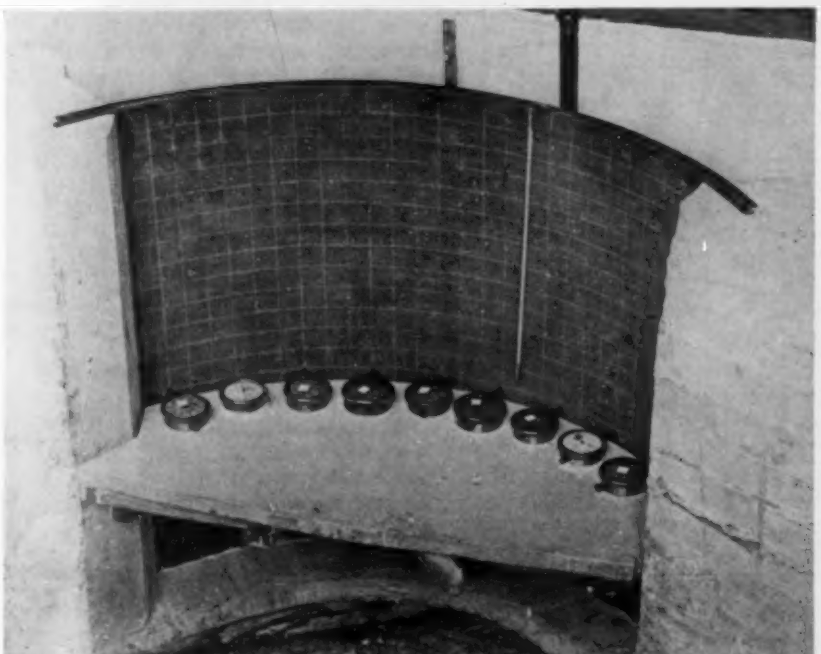


Fig. 1. Continuously Laminated Rubber Dam Showing Dials for Measuring Deflections

Fig. 2. Discontinuously Laminated Rubber Dam

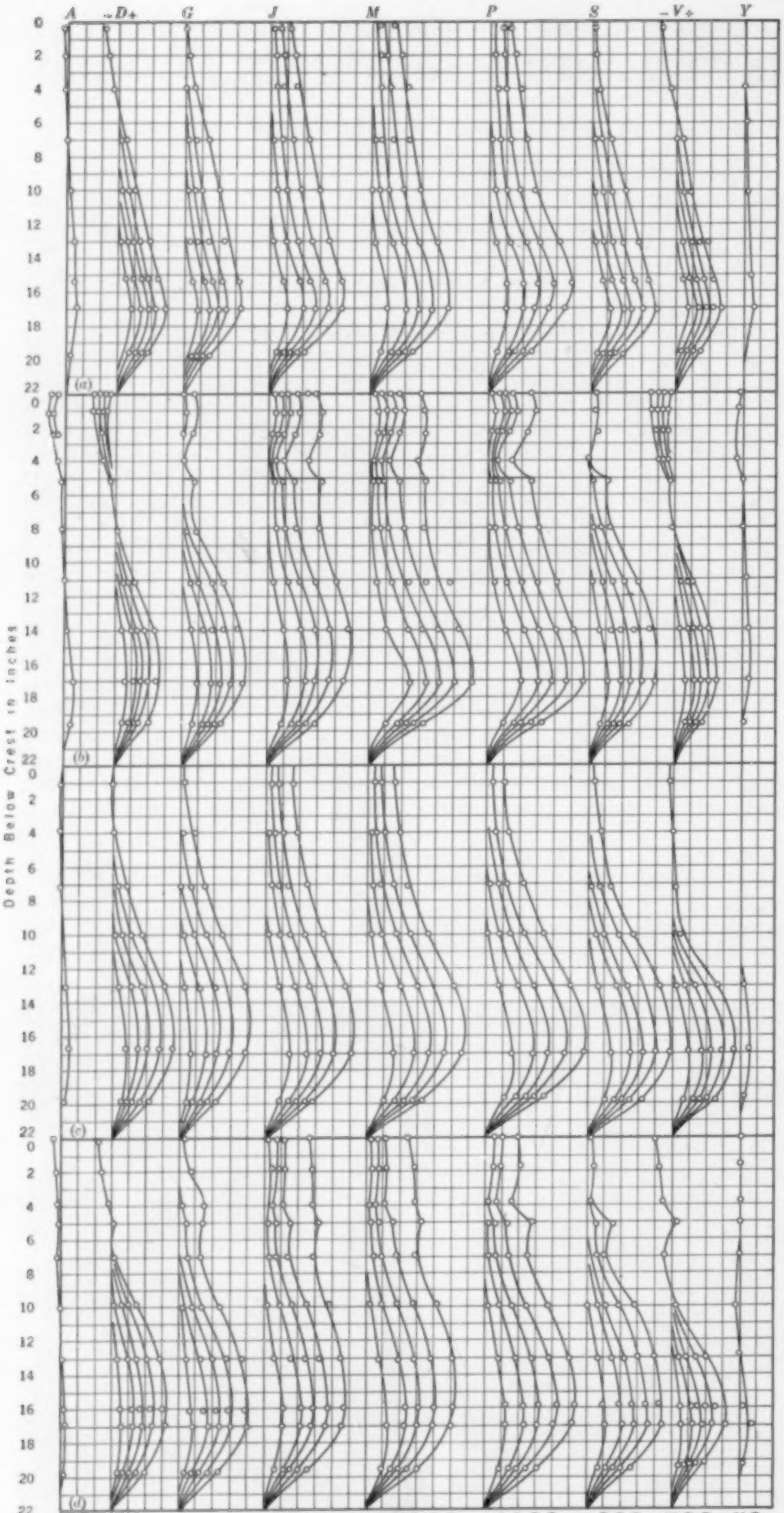


FIG. 3. DEFLECTIONS OF DAM MODELS AT 3-IN. INTERVALS
(a) Continuously Laminated, (b) Discontinuously Laminated, (c) Continuously Monolithic, (d) Discontinuously Monolithic

ing would certainly be unwarranted.

In trying to weigh the arguments for and against laminating, I became more and more absorbed by the complexities of the problem. A theoretical analysis of the simplest kind of arched dam indicates that there are regions where the shearing stresses would be greater than the expected frictional resistance of the laminas; and even larger regions where the shear would be insufficient to overcome friction. One is left with the question as to whether the tendency toward the relative displacement induced in places of heavy shear would be extended into areas where the shear was light, or whether the reverse would be true. That is just about as far as the theoretical argument can go even in the simplest case.

In 1931 I began the experimental study of laminated dams at Purdue University and finished the first stage of it in 1934 at Stanford University. At both these places substantial assistance was given in the form of equipment and funds.

The first investigation was a study of the friction developed between cement blocks, one of which was cast directly against the lubricated surface of another. The frictional force was then determined for various loadings and temperatures. Incidentally the bonding effect, which in some cases was a very substantial amount, was also studied. The results of these tests showed that a graphite paste, which entirely prevented bonding and produced a friction coefficient of 0.48 for high and low temperatures, was the most satisfactory lubricant. It was of some importance to obtain this information since if a suitable lubricant had not been found, it would have been useless to continue the investigation further.

PROPERTIES AND DIMENSIONS OF RUBBER DAMS

The next experiments were carried out on four model dams of a special rubber compound having elastic properties, as follows:

Density	136 lb per cu ft
Modulus of elasticity	5,200 lb per sq in.
Poisson's ratio	0.50
Coefficient of friction (surface to surface)	0.43

Each of these dams had a simple cylindrical shape in a rectangular valley. The dimensions were:

Constant radius	15.0 in.
Constant angle	106°20′
Span	24.0 in.
Height	22.0 in.
Total thickness	1.00 in.

It was desired to obtain a direct comparison between the deflections of two exactly similar monolithic and laminated dams. In its original form each model consisted of two $^1/_2$-in. thicknesses in contact without lubricant, as shown in Fig. 1.

TESTING RUBBER DAMS

In order to ensure exact similarity between the two dams of each pair, in every respect except in the laminating, the models were so arranged that they could be converted from the laminated to the monolithic type without changing the dimensions or the method of restraint at sides and base. The first type to be investigated was the continuously laminated. After the tests had been completed, the top 5 in. of the downstream lamina was cut away so that the model would be discontinuously laminated, as shown in Fig. 2. Following the tests on the model in this condition, the remainder of the downstream lamina was removed and then cemented back into place. This operation produced a discontinuously monolithic dam. The final operation was the cementing back into place of the top 5 in. to make a continuously monolithic dam. When all the tests were completed, the model in its final form was cut into test specimens from which the properties listed previously were determined. Incidentally, this cutting up of the monolithic dam showed that the cementation of the laminas had been so successfully carried out that the bond was as strong as the material itself.

The procedure of testing was as follows. The platform containing the nine radial dials was adjusted to some level on the dam, as shown in Fig. 1. After the dials had been tested for contact, and initial readings had been taken, water was admitted to the reservoir until it reached a level 11.4 in. below the crest, where the first deflections were determined. Readings were also taken at 8.0 in., 5.4 in., 3.0 in., and 0 in. below the crests. The reservoir was then emptied and the dial platform was adjusted to a new level. In this way several hundred deflections were determined for each dam.

RESULTS OF EXPERIMENTS ON RUBBER DAMS

Deflection patterns for each of the dams are shown in Fig. 3. The few omissions are due either to disturbance of a dial during a test, or to the failure of a dial to register when the deflection was very small. All the points for any one cantilever element were determined by the same dial for each of the dams. It is rather surprising to find from the deflection curves that the continuously laminated dam deflected less downstream and more upstream than did the corresponding monolith. The expected increased flexibility due to lamination materialized only in the case of the discontinuously laminated model.

An evaluation of the moments and thrusts at critical points from the deflections by means of the approximate equations given by H. M. Westergaard in the PROCEEDINGS of the Society for May 1928, Part III, pages 241–244, revealed some interesting results. Under the assumption that the friction developed between the laminas would produce a distribution of stress similar to that in a solid section in the neighborhood of the critical points, the maximum and minimum stresses in the arches and cantilevers of the continuously laminated model were very nearly the same as those in the continuous monolith. If the friction were zero, so that the distribution of stress in each lamina depended only on the normal loads, then the maximum and minimum direct stresses in the elements of the continuously laminated dam would be reduced and increased, respectively, by about 50 per cent for the cantilever elements and 20 per cent for the arch elements. However, even the most favorable assumption regarding the distribution of stress in the sections of the discontinuously laminated dam could not make the maximum and minimum stresses in it as favorable as those in the discontinuous monolith.

FIG. 4. MONOLITHIC PLASTER DAM

Hence it may be concluded that discontinuous laminations of the type examined would be undesirable. On the other hand, a continuously laminated dam would not be any worse than the corresponding monolith and might be somewhat better if some relative displacement of the laminas were to take place at the critical points.

EXPERIMENTS ON PLASTER DAMS

To obtain a more positive indication of relative displacements, some tests were carried out on three pairs of laminated and monolithic dams made of plaster of paris. These were cast in the same forms and similarly restrained at the base and sides. One of the dams is shown in Fig. 4. The laminated ones consisted of two $^1/_2$-in. thicknesses with graphite between. Each of the three pairs of dams were then tested to failure under different concentrated loadings. The results of these tests are shown in Table I.

TABLE I. RESULTS OF TESTS ON THREE PAIRS OF LAMINATED AND MONOLITHIC PLASTER DAMS

LOADING	TYPE OF DAM	LOAD AT FAILURE	TYPE OF FAILURE
I	Laminated	1,382 lb	Shear
	Monolith	1,890 lb	Shear
II	Laminated	1,085 lb	Shear
	Monolith	1,875 lb	Shear
III	Laminated	2,210 lb	Flexure and shear
	Monolith	4,700 lb	Flexure and shear

The very pronounced difference between the strengths of the monolithic and laminated types must be attributed to the adjustments of the laminas. Although the loading was very different from hydrostatic in each case, it is not unreasonable to expect that, under hydrostatic loading, relative displacements of the laminas would take place at such points of heavy shear as at the base of the cantilever elements. Such relative displacements would relieve the flexural stresses but lower the resistance to shear.

These tests conclude my experiments to date. The multitude of possible types of lamination makes any conclusions drawn from a few examples decidedly unreliable. However, it would seem that these tests give a fair idea of what might be expected of a laminated dam.

Rigid-Frame Highway Bridge in Austin, Tex.

Unusual Guard-Rail Features Accompany Pleasing Architectural Treatment

By L. A. Schmidt, Jr.

Associate Member American Society of Civil Engineers
Resident Engineer Inspector for the PWA, Pecos, Tex.

Combining beauty with utility, the rigid-frame bridge described in this article embodies a number of interesting methods of solving familiar design problems. The under side of the deck was laid out in the form of a flat parabolic curve. Continuous guard rails anchored to the reinforcing steel in the wing walls on both sides of the span provide unusually strong support for vehicles out of control. Those of our members who are familiar with the stop-and-go limitations of the different emergency work relief programs to date will sympathize with the obstacles encountered by the builders in construction under CWA, FERA, and LWD. Although dealing with a structure of modest dimensions, Mr. Schmidt's complete and detailed treatment of the various considerations involved will repay reading.

In designing the Upper Shoal Creek Bridge for the City of Austin, Tex., an effort was made to give the proper weight to both appearance and utility. In other words, it was desired to emphasize the fact that it is practicable to secure beauty in bridge construction and that such beauty is not necessarily "skin deep." Probably no field of engineering endeavor has such broad possibilities for producing pleasing effects as bridge construction; possibly no field of similar effort has been so much abused, owing to too great economy in appurtenances not basically useful.

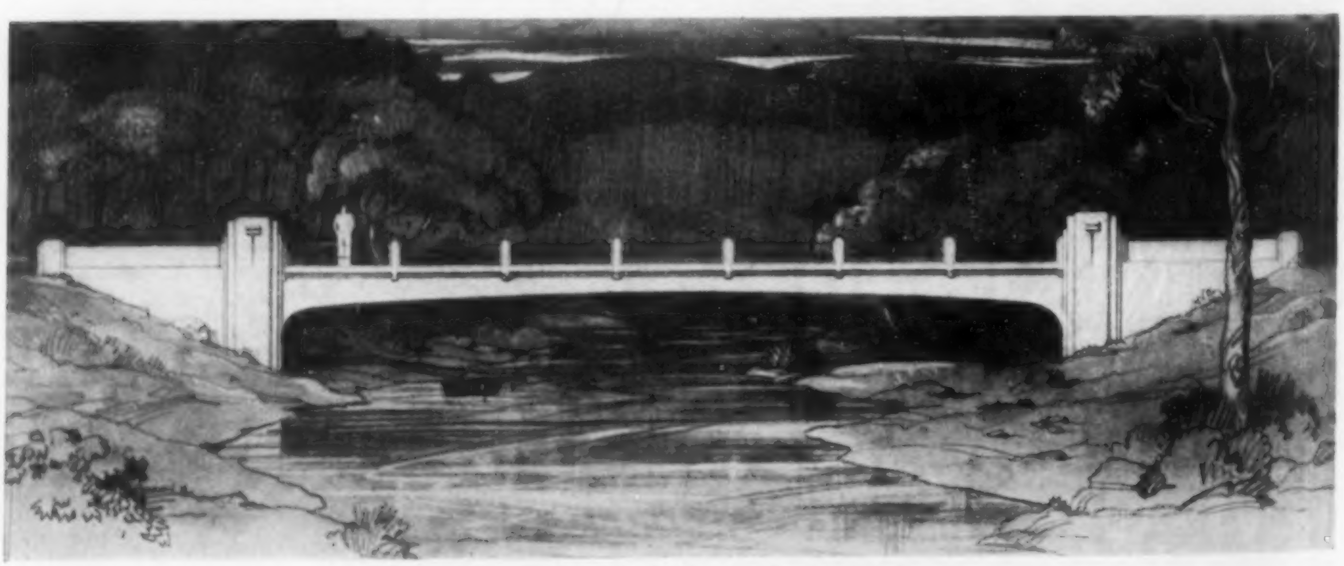
Governmental efforts toward recovery have placed at the disposal of municipal subdivisions an abundance of labor. A certain part of this has been employed in cleaning up, constructing, and beautifying parks, both old and new. The results of these endeavors are becoming noticeable, and in a short period of time have changed the attitude of the public toward construction. In connection with the nation-wide program of more leisure and improved environment, beautification is more and more being considered a worthwhile aim by those who are dealing with problems of design and construction.

One of the projects undertaken by the Park Division of the Texas Civil Works Administration was the development of a strip of land adjacent to both banks of Shoal Creek, which runs through a residential district of Austin. A boulevard, which is a much-needed traffic outlet for this area, was contemplated as a part of the development. Natural conditions made it desirable to construct two bridges across Shoal Creek, the side of one to be visible to the motorist for several blocks before he reaches the approach. The need for a utilitarian as well as an esthetically pleasing structure at this location is evident.

The city of Austin desired a cross-sectional area for water passage of not less than 500 sq ft at the crossing. But a bridge of any considerable height above the stream bed would have necessitated a long fill on the left bank. Such a design had two major disadvantages, the cost of building and maintaining the fill and the scar that the embankment would leave in the valley. Such a scar would have offset much of the other work being done to beautify the area. Tests revealed a hard, firm, water-tight blue clay, which is recognized as an ideal foundation material for a rigid-frame bridge with hinged footings. These circumstances, together with the adaptability of the rigid-frame bridge to pleasing architectural treatment, were the major factors that determined the type of structure to be built at the site. A single-span rigid-frame bridge of the slab type was finally decided upon, as shown in the accompanying artist's sketch and photographs, as well as in Fig. 1.

General Dimensions of the Structure

It was planned to lower the stream bed 2 ft at the bridge crossing. The clear span of the structure was



Artist's Drawing of the Shoal Creek Bridge

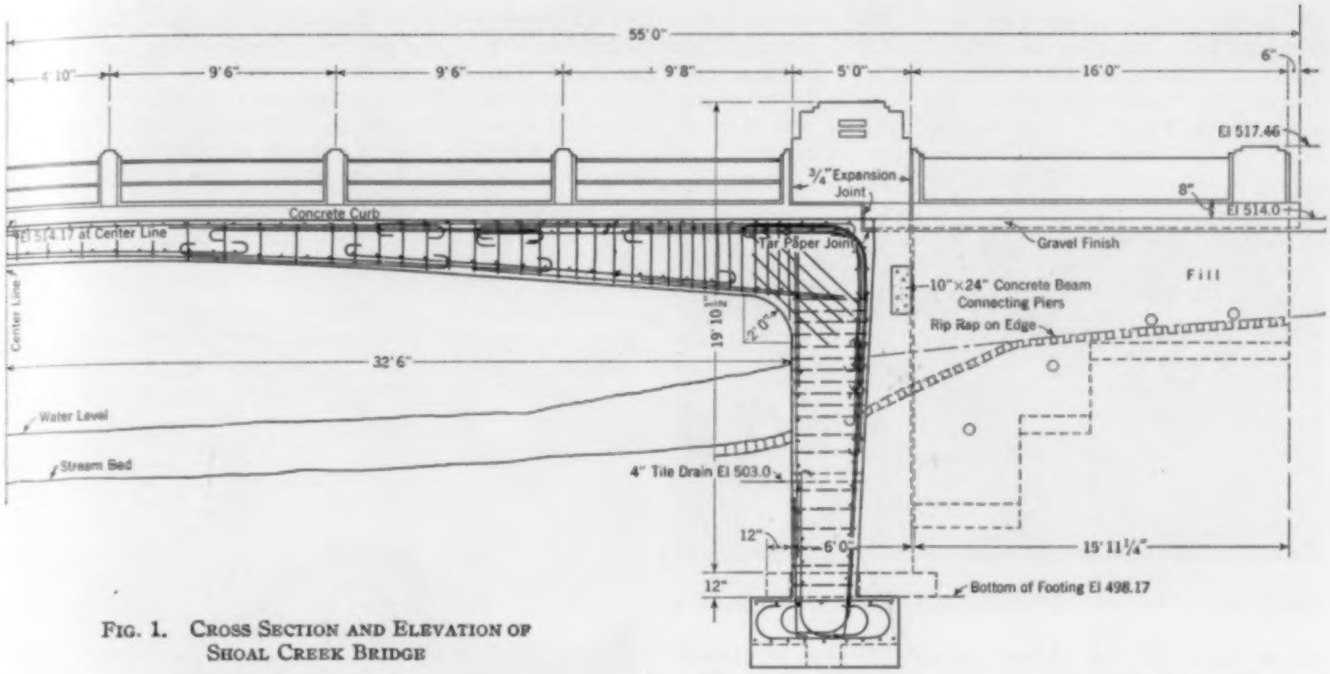


Fig. 1. Cross Section and Elevation of Shoal Creek Bridge

fixed at 67 ft, and the deck element was assumed to be 70 ft long. Since the blue clay foundation material is of indeterminate depth, it was decided to place the bottoms of the footings well into this material to provide as much resistance to side thrust as possible. The bottoms of the footings were therefore placed about 5 ft below the top of the clay. This satisfied the requirement that there should be not less than 6 ft of cover over them. As a further precaution against side thrust, ribs 12 in. deep and 18 in. wide were cast integrally with the footings and about 5 ft below their centers, both longitudinally and laterally. Excavations for these footings were made to exact size and entirely filled with concrete.

The resulting foundation pressures for the bridge itself were found to be slightly over $1^1/_2$ tons per sq ft, considering dead load only, and under 2 tons per sq ft, assuming the worst possible condition of live load. The blue clay underlying the footings could reasonably be assumed to be capable of supporting from 4 to 6 tons per sq ft without danger to the structure.

Each abutment was made 16 ft $2^1/_8$ in. high, including the depth of the footing. The final clearance under the bridge at the center of the span, after lowering the river bed, is 9 ft. At the crown, the slab is 22 in. thick, and at the support it is $42^1/_2$ in. thick. These dimensions include $^1/_2$ in. of concrete surfacing, which was included in the dead load but not considered effective in resisting moment. At the top of the abutment the walls were made 42 in. thick, and at the top of the footings, 33 in. thick. The footings are 6 ft 3 in. wide and 2 ft deep, exclusive of the underlying ribs.

A flat parabolic arch was designed, with fillets of 2-ft radius at the haunch. These fillets are not strictly necessary, but they provide an additional factor of safety at the haunch at practically no extra cost. In Fig. 1 appears a half cross-section and elevation of the bridge. The roadway of the bridge has a clear width of 24 ft between curbs, and the deck slab has an over-all width of 25 ft 4 in., excluding the ornamental curb, which adds 8 in. additional on each side. The deck has a transverse camber of $1^1/_8$ in., both top and bottom. At the crown a longitudinally distributed rise of $^1/_2$ in. was allowed for possible settlement.

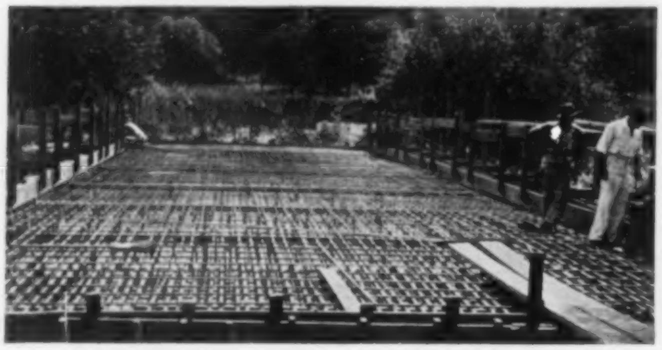
Particular attention was given to modern traffic requirements. The curbs are so arranged that the hub caps on cars of the latest model would not touch them. It was contemplated that the tires should hit the curb first, and that in case of a mishap no part of the rail should come into action before at least a wheel was broken. On a bridge of this width it is believed that a curb depth of 8 in. is ample to stop a car before it can climb the curb, and at the same time clear the hub caps. Curbs were given a width of not less than 7 in. to protect the faces of rail posts, ornamental piers, and approach retaining walls against damage from fenders and conversely to protect the fenders from contact with the walls.

Because of conflicting requirements for appearance and stability, one of the most difficult problems to be solved in bridge construction is rail design. The rail designed for the Shoal Creek Bridge is a departure from standard practice, but is believed to be a satisfactory solution. In order to emphasize the slenderness of the structure, two round chromium-plated steel rods $1^1/_4$ in. in diameter were used for each rail. These rods were screwed into wrought-iron pipe couplings of 1 in. nominal diameter inside the rail posts, openings having been left in these posts by $1^1/_2$-in. galvanized iron pipe sleeves. The rods are carried into the ornamental piers through pipe sleeves, and are there connected by means of a heavy iron plate to anchor bars extending into the piers from the retaining walls. The connections were made inside the ornamental piers, and access to them was provided by a manhole in the top of each pier. These rods were put into tension to counteract the effects of expansion. In case of an accident on the bridge so severe that a car would tend to overturn, the bars would be thrown into tension, so that the vehicle would be supported by these continuous anchored rods as well as by the rail posts. It may be seen that this design has the distinct advantage that the rail is not dependent entirely on the strength of the posts. Clearances at the ends of the span are so arranged that any rod can be taken out and replaced without removing the entire railing.

Design of Concrete and Steel

Design stresses adopted for the deck and abutments were 1,000 lb per sq in. for the concrete, and 18,000 lb

per sq in. for the reinforcing steel. The concrete was designed for a breaking strength of 3,000 lb per sq in. at 28 days. The value of n was taken as 10. The arrangement of the reinforcing steel in the deck and abutments is shown in Fig. 1. A photograph shows the steel in place in the deck, ready for concrete. Concrete was mixed in the nominal proportions of $1:2:3^1/_2$, using $6^1/_2$



REINFORCING STEEL OF DECK IN PLACE, READY FOR CONCRETE

gal of water per bag of cement and 5.9 bags of cement per cubic yard of concrete. A slump of from 4 to 6 in. was maintained, depending on the arrangement of the reinforcing steel, and was controlled by varying the total amount of aggregate. The average breaking strength of 17 cylinders taken during the pours was 3,600 lb per sq in. at 28 days.

The footings were poured with 2,500-lb concrete furnished by a local transit mix company. Design stresses, except shear and bond, were found to be of no material importance because the depth of the footing was determined by the area that would give satisfactory side-thrust pressures against the adjacent foundation material. The bridge was designed for the standard H-15 loading. Wheel loads were assumed to be distributed over 4 sq ft, since it is possible to get 3 trucks on the bridge at the same time. Impact was taken at 25 per cent.

VARIOUS FACTORS DETERMINED AND CHECKED BY COLUMN ANALOGY METHOD

Fixed-end moment coefficients, carry-over factors, and stiffness factors for uniform loading and different positions of concentrated loads were determined by the principle of moment areas and checked by the column analogy method for both deck and abutments. Actual shears, maximum and minimum moments, and corresponding thrusts were then determined at frequent intervals along these elements, and Fig. 2 shows the resulting maximum positive and negative moment curves for the deck element.

Stresses in the deck were checked at frequent intervals, and it was found that governing stresses were reached only at the haunch and at the crown. The intermediate stresses were found to be comparatively low. Experience would seem to indicate that some economy can be effected in rigid-frame bridges by using concrete of different strengths in various parts of the bridge and adjusting the deck shortening stresses to the higher values for n. For example, a 3,000-lb concrete at the haunch and the middle quarter of the slab would satisfy stresses at these points. Leaner concrete, down to 2,500 lb per sq in., or even 2,000 lb, could be used in the remainder of the deck and the lower parts of the abutment walls. Even with fairly high stresses, the concrete in such a structure would still have a factor of safety against ultimate failure as great as that of the reinforcing steel at the yield point because of the parabolic form of the stress-strain curve for ultimate stresses in concrete. It is conceded that the deck thickness would not necessarily have followed a parabolic line from crown to haunch to keep the working stresses nearly constant, and that some slight economy could have been effected here; but from an esthetic viewpoint the long, flat, arching parabola cannot be surpassed.

Except for housing the connection between the bridge rails and their anchorages, the piers at the abutments are ornamental only. Expansion joints separate the piers from the main structure and the retaining walls. A reinforced concrete cross tie behind the principal abutment walls joins companion piers at each end of the

RAIL AND CURB OF COMPLETED BRIDGE

bridge and adds to the stability of these hollow structures. It is felt that the piers, which are of 2,000-lb concrete, have contributed a great deal to the modern appearance of the bridge.

The rail posts, retaining walls, and approach piers carry out the lines suggested by the main piers. When the bridge is viewed from the side, the exterior of the curb section, which overhangs the deck slab, casts a shadow on it, accentuating the slender appearance of the structure. Indirect lighting has been provided on both sides of the piers, that is, on the inside and outside of the bridge.

DIFFICULTIES CAUSED BY INTERMITTENT LABOR SUPPLY

Constructing a bridge of this type with CWA and FERA labor presented many problems not ordinarily met with. Concrete was mixed in two 2-bag mixers, and experienced skilled labor was at a decided premium. A carpenter foreman, aided by such carpenter help as could be found on the relief rolls, built the forms under the direction of the superintendent and engineer. After two days of setting reinforcing steel, all the available steel setters had worked out their budgets for that period. Such delays naturally were not conducive to rapid progress. The labor problem was especially acute in connection with the pouring of the concrete. The bridge above the footings was poured in two sections, separated by a longitudinal bulkhead the length of the bridge and abutments. Only two mixer operators were available, and the budget time of one of them was up halfway through the second pour. Fortunately the engineer was familiar with mixer operation and was able

SIDE VIEW OF SHOAL CREEK RIGID-FRAME BRIDGE
Shadow of Offset Curb Section on Spandrel Accentuates Slender Effect

to complete the pour. There were almost no puddlers to be had. Practically, the superintendent and the engineer were personally responsible for all the face spading on the bridge. Budgets were worked out beginning at 8:30 a.m. and continuing throughout the day, but if six laborers had not been transferred from another park project, the already short-handed job might have ended disastrously.

Work on this structure consumed much more time than would have been required under contract conditions. The ground was broken on March 17, 1934, and the footings were poured on March 31. The latter date marked the end of the CWA, and considerable time elapsed before the FERA was instituted. With the footings poured, the job was shut down until May 7, and on May 14 a shortage of budget hours and relief appropriations made it imperative to shut down again. Nothing further was done until June 12. On July 11, half the deck and half the abutments were poured, and two days later the remaining halves were poured. Thereafter work continued intermittently on the architectural treatment, retaining walls, and backfilling until November, when the bridge was finally opened to traffic.

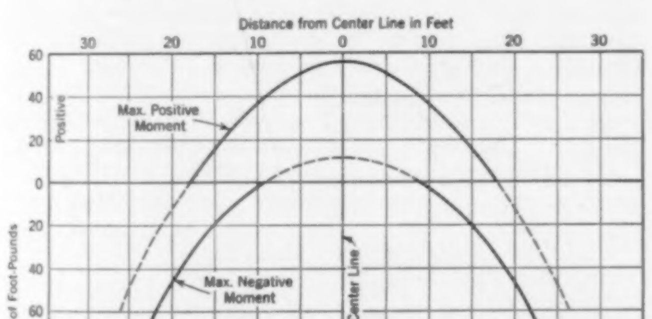


FIG. 2. MAXIMUM BENDING-MOMENT CURVES FOR SHOAL CREEK BRIDGE

UNIT PRICES FOR THE WORK

In view of the circumstances under which the bridge was built, the following unit costs, which include supervision and miscellaneous costs, do not seem excessive, especially when allowance is made for the time required to complete the work:

2,000-lb concrete	$7.41 per cu yd in place
2,500-lb concrete	7.10 per cu yd in place
3,000-lb concrete	7.82 per cu yd in place
Reinforcing steel	0.047 per lb in place
Forms	0.677 per exposed surface foot
Wet excavation, including pumping and shoring	5.113 per cu yd

Acknowledgment is made of suggestions offered by F. A. Dale, M. Am. Soc. C.E., departmental head of the Parks Division of the Texas Civil Works Administration and Relief Commission; by Guiton Morgan, Assoc. M. Am. Soc. C.E., city manager of Austin, Tex.; and by S. P. Finch, M. Am. Soc. C.E., Professor of Civil Engineering, University of Texas. A review of the structural design of the bridge was made by A. Staubach under the direction of G. G. Wickline, M. Am. Soc. C.E., bridge engineer of the Texas State Highway Department; and also by A. J. Boase, M. Am. Soc. C.E., of the Portland Cement Association in Chicago. As designing engineer for the parks division of the Texas Relief Commission, I had charge of the structural design of the bridge, being assisted by Paul M. Enright. Charles A. Millhouse was responsible for the architectural treatment. The superintendent in charge of construction was James Patterson.

Urgent Problems in City Development

Showing How They Are Modified by Current Economic Conditions

By Thomas Buckley

Member American Society of Civil Engineers

Assistant Chief Engineer and Surveyor, City of Philadelphia, Philadelphia, Pa.

PUBLIC support is essential in putting into effect proposed community betterments, because administrative approval is rarely obtained unless public opinion is known to be favorable. In order to secure this support, plans must be sensible, dependable, and designed primarily for present needs. As the form of the American city today is fairly well standardized, city planning activities should be directed in general to zoning, control of growth, and studies of industrial trends rather than to costly reconstruction projects. Present unsettled economic conditions have added an element of uncertainty in estimating municipal resources. A detailed treatment of these and similar considerations is given in this article, prepared from a paper read by Mr. Buckley on September 25, 1934, at the congress of the American Society of Municipal Engineers and the International Association of Public Works Officials in Rochester, N.Y.

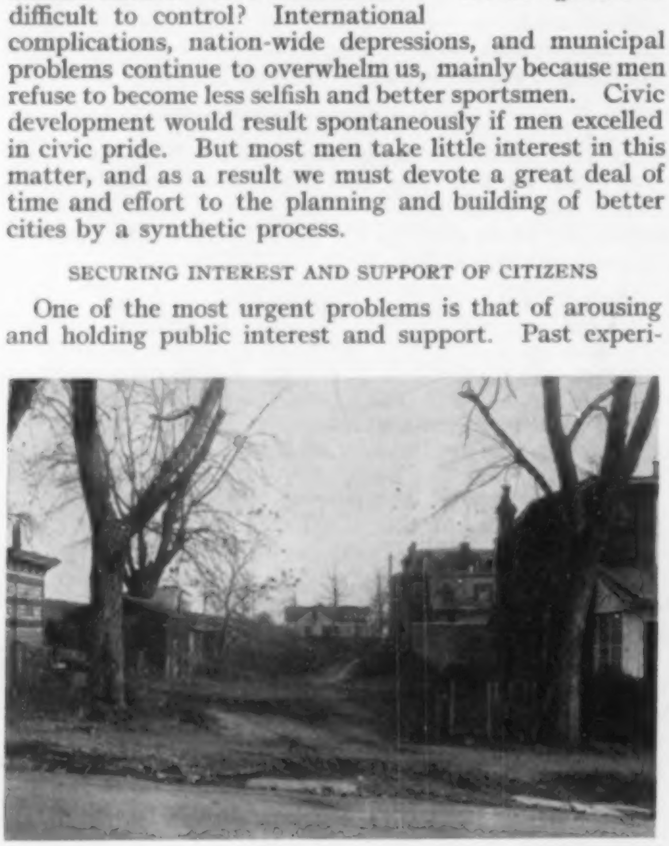
NO class, professional or otherwise, has a greater interest in the development of towns and cities than public works officials and municipal engineers. These constitute an important group under present conditions not only on account of the prominent place which they occupy in the administration and development of municipal functions, but also because of their renewed opportunities and responsibilities in the problems of city development. This article will concern itself with the latter aspect.

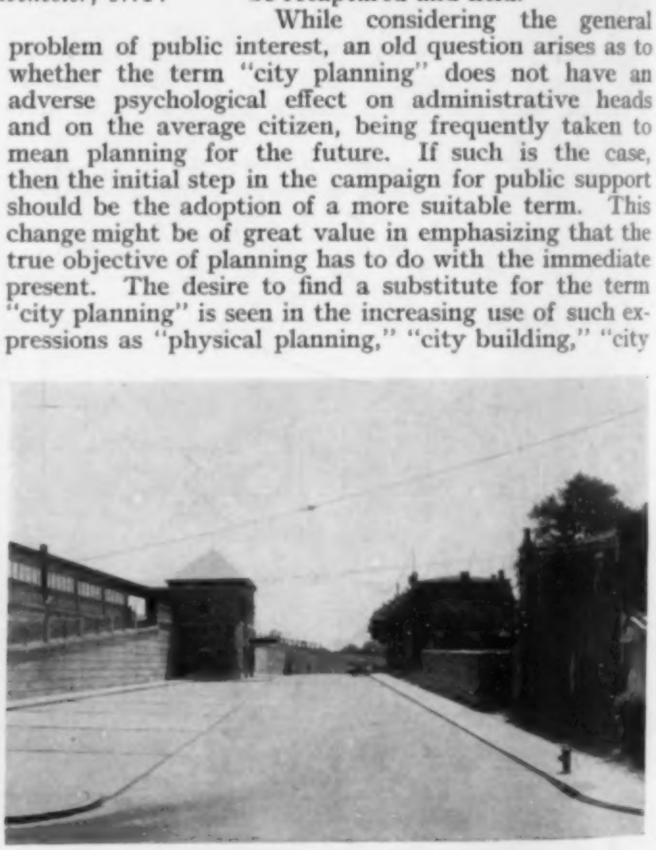
Some of the most pressing problems in city development have to do with conditions essentially simple in nature. The human equation plays an important part in all such, providing the key to many of the muddles and riddles that harass us. What can be more elementary than human nature? Yet what is more difficult to control? International complications, nation-wide depressions, and municipal problems continue to overwhelm us, mainly because men refuse to become less selfish and better sportsmen. Civic development would result spontaneously if men excelled in civic pride. But most men take little interest in this matter, and as a result we must devote a great deal of time and effort to the planning and building of better cities by a synthetic process.

SECURING INTEREST AND SUPPORT OF CITIZENS

One of the most urgent problems is that of arousing and holding public interest and support. Past experience teaches that no matter how meritorious the planning may be, it seldom arouses sufficient enthusiasm of itself to bring about the proposed betterment. Even city planning commissions, from whom so much is expected, rarely function except in an advisory capacity. Failure of the average citizen to appreciate the advantages of planned development makes this problem doubly difficult and is the direct cause of the usual apathy evidenced toward movements for civic betterment. In some sections this apathy has been partially due to over-planning by local officials, and in others, to the fostering by officials of unsuitable developments. Any unfavorable impressions which may have been thus created in the minds of the public must be removed before its active interest in planned development can be recaptured and held.

While considering the general problem of public interest, an old question arises as to whether the term "city planning" does not have an adverse psychological effect on administrative heads and on the average citizen, being frequently taken to mean planning for the future. If such is the case, then the initial step in the campaign for public support should be the adoption of a more suitable term. This change might be of great value in emphasizing that the true objective of planning has to do with the immediate present. The desire to find a substitute for the term "city planning" is seen in the increasing use of such expressions as "physical planning," "city building," "city





A Railroad Station and Its Approaches Effect a Pleasing Change

Before and After Raising Railway Grade. Looking South Toward Wyndmoor Station, Philadelphia, on the Germantown and Chestnut Hill Railway

Philadelphia Developments Present and Planned
Airplane View Looking Northwest Over the City, with Some Projected Developments Superimposed. The Art Museum and Parkway Group East of the Schuylkill (Upper Right) and the Post Office and Pennsylvania Railroad Station on the West Bank (Upper Left) Are Among the Most Recently Completed of the Planned Improvements

rebuilding," and the term appearing in the title of this article, "city development." In general, public interest must be won before administrative approval is given, and this approval is ordinarily so difficult to obtain that it is frequently mentioned separately as a very urgent problem. However, if public interest is won and held, official approval must ultimately follow.

The guarantee most needed to secure public interest and support is the assurance that the developments are designed for present needs primarily, and are based on sensible and dependable plans. These two essential features will be considered in the order indicated.

Roosevelt Boulevard, Philadelphia
Benefits Derived from Tree Plantings Far Outweigh Costs

In the past there has been too little planning for the needs of the immediate present. In the future it may become increasingly difficult to convince the public of the necessity for developments that benefit coming generations mainly, if the present generation is expected to pay a large share of the cost, and particularly if it is obvious that present needs are more urgent. Developments most likely to be undertaken, during the next few years, will be those fulfilling present requirements, with reasonable provision for future growth. However it should be noted that many cities have neglected maintenance work during the past few years and may be unable to finance urgently needed major improvements for a long time to come.

Plans must be as sensible and dependable as possible. Sensible plans guard against the attempt to re-plan cities in too ambitious a fashion. While every major development can be planned on a number of different scales, the municipality's choice is ordinarily determined by its ability to pay. Rational planning should find ways and means for developing each town and city in the way best suited to its social, economic, and political needs, having due regard for its financial resources. Rational planning will also take care that no single development is pushed forward at the expense of other equally worthy but less spectacular improvements. It is interesting in this connection to note that although very little has


GRADE SEPARATION PROVES GOOD INVESTMENT
Intersection of Willow Grove Avenue, Philadelphia, with Germantown and Chestnut Hill Railway, Before and After Improvement

been accomplished to date in developing our neighborhoods, cities, and regions, we are now attempting to re-plan the nation, the 48 states, the 3,070 counties—not to mention industry, business, agriculture, commerce, and other resources. Yet there are possibilities in national planning as long as it holds to its fundamental aim of cultivating or restoring and preserving the economic resources of the nation. To summarize, sensible planning will not stampede municipalities into an orgy of spending on developments beyond their resources.

Dependable plans must be based on complete and accurate data relating to physical, economic, and social conditions, and must provide for only such developments as are to the best advantage of both the individual citizen and the community at large.

No attempt should be made to conceal the cost of proposed developments. The present plight of the taxpayer may make him more critical than ever in the future, and if cost data are not made available to him he may prove obdurate when his support is solicited. The city planning movement has been hurt by the over-zealous planners of the past, and this mistake must not be repeated.

IMPROVING THE STRUCTURAL FORM OF CITIES

A second urgent problem in city development has to do with the structural form of cities. It may be expressed as a study of how the present form may be perfected in the light of past experience, and in view of what may reasonably be foreseen of the future. While it would be unwise to try to anticipate the form that cities may have in the distant future, it is equally unwise to overlook the fact that past centuries have witnessed no radical changes in their structural form. Such changes as did occur affected mainly the individual elements that combine to form the structure as a whole. This fact is accepted by many as evidence of the basic soundness of the general scheme. Creditable attempts have been made, in some instances, to harmonize certain elements and to improve the appearance of the general pattern. But certain other elements have become so firmly established with relation to high land values that the possibility of radical changes in design has become smaller and smaller.

In an address before the Civic Development Department Round Table, at the annual meeting of the U. S. Chamber of Commerce in Washington, D.C., on May 2, 1934, Harland Bartholomew, M. Am. Soc. C.E., said: "Economic necessity compels a new consideration of the structural form of the American city. Is it altogether sound and good? Is it fixed in form or is it undergoing a fundamental process of change? What improvements, or controls, if any, would be most desirable? These are questions of profound interest to all concerned with the welfare of that half of the total national population which lives in cities." The most serious faults in the structural form of the American city today relate to the quality, harmony, coordination, and balance of various elements rather than weakness in the basic scheme. This conclusion is supported by the fact that planners, in laying out a new city for the future, accept this basic form as the result of certain governing principles.

Even if it is believed that the present structural form of our cities is sound, there still remains the problem of raising the standards within them. Solution of this problem involves improving the quality of the individual elements, providing for a more efficient and economic distribution of elements, decreasing conflicts between certain elements, and creating a better balance and more perfect coordination between the whole and its parts. The cost of accomplishing these ends by reconstruction has been in the past prohibitive to a large degree. However, a means of gradually improving the structural form of municipalities has been suggested through the medium of three different controls: zoning, control of extent of growth, and decentralization.

Zoning is the only one of these three controls now being tried. It is as yet far from being in a perfected stage, but has become firmly established under the police power. While remarkable progress in the zoning movement has been made in recent years there is still room for improvement in local districting and administration. In its districting of uses, zoning for the most part recognizes as standard the present structural form of the city. It has repeatedly failed, however, to establish a proper balance or relationship between certain important elements, such as active and potential use areas.

Although the control of extent of growth is as yet an untried theory, it is recommended by many competent planners as the surest means of saving our towns and cities from the disastrous results of further exploitation of land. The wholesale urbanization of suburban and even rural lands in numerous cities during the boom period of the last decade was largely instrumental in bringing about their subsequent financial distress. Where diminishing population growth and resources must be reckoned with, it is absolutely necessary to limit ex-

ELIMINATION OF DEPRESSION PREVENTS FLOODING

Looking East on Chelten Avenue at Old York Road, Philadelphia, Before and After Regrading. White Shields on Poles Indicate Extent of Grade Revision

pansion. The establishing of such a control represents a hard problem, however, on account of the interests involved, the necessity of being absolutely equitable, and the difficulties attending legalization and administration.

Decentralization has been put forward for a number of years as a cure for the growing pains that beset the modern city. The supporters of this plan are advocating it strongly now that renewed interest in city development has been awakened. In this connection, Harland Bartholomew says:

"Decentralization which merely involves abandonment of existing cities or parts of cities and offers no social and economic concept of an equal or higher standard for the city as a whole, is unworthy of consideration. Until some sound method of decentralization is proposed, we can best devote our attention to the correction of bad practices attendant upon the otherwise sound form of city. The present form of city is entirely sound; the errors are due entirely to the manner in which it was exploited. America has passed its frontier in urban development as truly as it has in national development. Our policy of the future must be conservation as opposed to exploitation."

An uncertain and perhaps a dangerous element in the control of decentralization is the final effect that it might have if applied to the industries of a municipality where economic decadence is incipient. In commenting on industrial decentralization, Jacob L. Crane, Jr., M. Am. Soc. C.E., says in the *City Planning Quarterly* for July 1934:

"We find that, as yet, the very popular idea of industrial decentralization remains an almost unanalyzed concept of something that might be desirable. . . . If we are going to find out how good the idea really is, if we are going to determine the arrangements which must be made to bring it about, and if we are going to encourage or introduce the forces which will cause it to happen in the way we find we want it to happen, a big research and planning job has to be done."

INDUSTRY IGNORES ARTIFICIAL CONTROLS

Industry constitutes the principal economic resource in many towns and cities, but there was not enough industry to satisfy all, even in the boom years. Furthermore, industry is subject to such far-reaching influences and such variable and subtle factors that the ability to decentralize at will, without disastrous results, may be seriously questioned.

As an illustration of some of the conditions to be met the industrial characteristics of two typical states will be given. In New Jersey, during the period 1928–1929 industrial changes indicated a definite trend toward decentralization. The number of changes involved are shown by the following statistics:

New industries established	324
Industries relocated	77
Industries that came from other states	32
Industries idle, removed, or out of business . . .	1,092

In the state of Michigan, during the same period, industrial changes indicated a trend toward centralization, and involved movements as follows:

New industries established	366
Industries relocated	26
Industries that came from other states	10
Industries idle, removed, or out of business . . .	582

A few years ago, the city of Philadelphia lost two important, long-established industries for reasons entirely beyond its control. One was a large ship- and engine-building company, which went out of business with the collapse of this industry. The other, reputed to be the largest locomotive-building plant in the world, left the city in order to occupy a more suitable location. In normal times, the two establishments referred to together employed from 15,000 to 16,000 persons. These great plants stand empty today as monuments to the ruinous effects of industrial decentralization induced by economic laws.

These illustrations emphasize the oft-repeated warning that industry is subject to forces which will not respond readily to artificial controls. Adverse industrial changes may occur unexpectedly, at any time, and with such occurrences may come serious economic and social losses. Can such changes be avoided, or can they be brought about by voluntary efforts toward decentralization? Will economic losses follow an attempt to decentralize industry in a section where the natural trend is in the opposite direction? What effect will decentralization have on the enormous investments represented by the one hundred metropolitan districts of the nation? These and related questions are our problems. Decentralization, seriously considered, requires far more knowledge of the factors involved than has ever been possessed in the past. If eventually undertaken, wisdom

dictates the need of a sufficient factor of safety, among other considerations.

FINANCING PLANNED CITY DEVELOPMENTS

The third and last of the urgent general problems has to do with finance. Having aroused public interest in the proper kind of planning for developments that will perfect the structural form of the city, how are the citizens to purchase this betterment? Several factors have an important relation to this question.

Population trends have a more or less definite bearing on the extent to which development can be undertaken. Of 61 average American cities, varying in population from 25,000 to 500,000, 21 had their greatest population growth from 1900 to 1910; 20, from 1910 to 1920; and 20, from 1920 to 1930. It is obvious that cities such as those of the first group, which show a continuous decline in population growth, must approach the question of new developments with care.

The extent, character, and vitality of industrial and commercial resources is also of importance in determining the financial ability of a municipality. Today no city knows with certainty what resources it will ultimately have after the depression has ended and reconstruction has begun. Any extensive redistribution of industry and commerce would impair the financial status of a number of cities. If the planned development of cities is to become contingent on their ability to entice industry and commerce from sister cities, then city planning will indeed be undone.

Real estate taxes to date have been the chief source of income in most cities. These are today vexed by the problems of diminishing land values, equitable tax rates, and delinquent taxes. A factor here that has been largely overlooked is the relation that the number of taxpayers and other individual revenue producers bear to the population growth. In the opinion of the writer there were, in some cities, numerically fewer "revenue producers" in 1930 than in 1920. Conclusive data on this important point are difficult to obtain, and therefore are seldom available in large cities, or if available are never published. Emigration of higher income groups from cities, immigration into cities of lower income groups, marriages, and divorces, birth and death rates, mortgage foreclosures and sheriff's sales, industrial and commercial mergers and failures are factors that enter into this particular problem. For some time to come all municipalities will have to give strict heed to their sources of income if developments are to be undertaken with balanced budgets.

While housing is not a problem born of the depression, planning in the past has simply failed to concentrate on it. During the boom years, well-organized but unsuccessful efforts were made to bring about both rehousing and remodernization on a large scale in obsolescent areas. If these moves were unsuccessful in prosperous times, we must not be discouraged if progress is slow during the lean years. The problem of housing the lowest-income classes remains unsolved. The lack of self-respect, the absence of civic pride, and the constant urge to vandalism among these classes in the large cities are related factors of consequence in the general problem of housing.

FRONT AND REAR OF TYPICAL RESIDENTIAL DEVELOPMENT, PHILADELPHIA
The Residence Continues to Put Its Best Foot Foremost—Rear Yards with Built-in Garages Compare Unfavorably with Fronts

MUNICIPAL ATMOSPHERE PRESENTS LOCAL PROBLEM

The fourth urgent problem is designated here as primarily local in significance, solely because its controlling factors vary in different localities. Actually, it is a problem of the first magnitude, embracing those internal and external influences that combine to establish the present or potential status of a municipality. This problem, in lieu of a better name, may be called the problem of municipal atmosphere. The atmosphere (as implied here) of a city is made up of local conditions which may seriously handicap planned development if their influence is adverse. These factors include population trends; proximity to much larger and more favorably situated cities; volume, vitality and stability of economic resources; extent and permanency of sustaining resources in hinterland; natural trend toward concentration or decentralization; severity of sectional competition for commercial and industrial assets; freight rates, differentials, lighterage, and load factors; amount of local capital invested compared to foreign capital; extent and nature of existing rigid features and existing developments; local attitude of citizens toward progressiveness; relation between population growth and number of taxpayers; policy regarding the provision of public improvements for private interests; effect of competition between existing and proposed commercial and housing developments; extent to which public improvements have been duplicated for same population; extent to which the exploitation of land exists or can be controlled; and the conception of community responsibilities.

Structure of the Civil Engineering Profession

Results of a Study Based on the Listings in the Society's 1931 Year Book

By Theodore J. Hoover

Dean of the School of Engineering, Stanford University, Stanford University, Calif.

A TIME of stress is always an occasion for self-analysis. During the past few years many engineers have been making studies of the profession. One of the constructive results of such studies is represented by this article, which attempts to analyze the designations by which engineers are prone to classify themselves. Such efforts should result in a more rational terminology for use by civil engineers. Dean Hoover's analyses have been available for study and have been utilized in part in recent questionnaires relating to the civil engineering profession issued by the Society and by the U. S. Department of Labor. This article is one of a series of studies on the structure of the main fields of engineering, the others of which are being published by other engineering societies. Those interested in the general program and the results of such analysis of the profession as a whole are referred to Dean Hoover's article, "The Structure of the Engineering Profession," which was published in the "Journal of Engineering" for January 1935.

WHAT are the chief branches of the civil engineering profession today? In an effort to analyze the structure of this field of engineering, a quantitative study has been made of the membership of the American Society of Civil Engineers, here reported for the first time.

The process of subdivision of the civil engineering group into a large number of specialties has advanced much further than most of its members realize. Nearly two hundred different kinds of engineers were found among the titles given after the names in the 1931 Year Book of the Society. These ranged from "accounting engineer" and "advisatory engineer" to "works engineer" and "zoning engineer." No more than 3 per cent of the group described themselves merely as "civil engineer," and it would seem that the traditional scheme of classification as civil, mechanical, electrical, mining, and chemical engineering has been considerably broken down into the respective special subdivisions. This quantitative fact analysis of the special branches of civil engineering is reported in the belief that it will be of no little interest to all engineers in this group.

Society Year Book Titles Studied

For this purpose the Year Book of the Society for 1931 was chosen as most representative of recent years. An alphabetical frequency list of every variation of title given after the names of all the members in that volume was prepared, and was classified in several different ways in an effort to reveal the true structure of the civil engineering field.

In making these classifications, the effort to obtain an unclouded picture of the profession was complicated by several kinds of misleading usages in title nomenclature: (1) Many of the words used in titles have no well-defined and widely accepted meanings and are difficult to interpret. (2) Many titles are not descriptive of the function the engineer performs and the place he occupies in the vast domain of engineering activities; such titles are therefore meaningless to those who hear or read them. (3) There is indiscriminate use of two different kinds of title: the professional title indicative of the branch to which a man has devoted himself, such as "highway engineer," and the title of his rank or position in an organization, such as "assistant city engineer and superintendent of streets." For the present purpose, only the professional title is revealing. (4) Frequent use of the unmodified term "engineer" is justifiable only if the possessor is competent to practice in almost any segment of the broad realm of engineering. If a man's career has been closely associated with any special branch, it is more informative to have him designate this by calling himself a "civil engineer," a "bridge engineer," a "hydraulic engineer," a "research engineer," or the like. (5) About 70 per cent of all the titles found were unique. A division of engineering which has only one representative in the whole American field cannot be a very important subdivision of that field. All these five types of confused nomenclature have added to the difficulty of properly interpreting the frequency lists here to be presented.

Including all variations in title of the 14,518 members in the 1931 Year Book, the basic list revealed a total of 1,914 different titles, without any attempt at grouping and considering, for example, the title "civil and hydraulic engineer" to be distinct from "hydraulic and civil engineer." Out of these 14,518 men there are 2,710, or 19 per cent, who gave no title. Of the remaining 11,808 who gave titles, 361, or only 3 per cent, gave simply "civil engineer," and 669, or 6 per cent, gave simply "engineer." The length of the titles given varied from one to 18 words. There were 1,315 unique titles in the group, or 69 per cent of all the different titles found!

A first attempt was made to reduce this list on the basis of numerical frequency. The 89 most frequent titles in the list, all of which appeared more than 15 times, are given in Table I. Although this list is based on a count of the commonest titles used by the men in the group, and takes care of 8,423 names, or 71 per cent of all who gave titles, it is still far from revealing much in regard to the important branches of civil engineering. A great many of the titles listed indicate rank, such as "president," "chief," and "manager," rather than special branch. Again, some of these titles, such as "draftsman," "designer," "architect," and "contractor" might imply that the men giving them do not consider themselves to be engineers; if the man is an engineer, it seems clear that he should use that word in his title. Moreover, even if only those who specifically designate themselves as engineers are considered, they may classify themselves from several different points of view. It is obvious, for example, that modifying words like "research" and "sales" are of a different sort from words like "structural" and "bridge," and that words like "consulting" or "chief" are of sorts still different.

Adjectives Modifying "Engineer" in Titles

Accordingly, a second attempt was made to achieve some sort of order by selecting from the alphabetical list all the adjectival terms to be found modifying the

word "engineer," thus ruling out all the men who did not classify themselves primarily as engineers. These modifying adjectives, which indicate a total of 197 branches of engineering represented by Society members, were then sorted into eight groups of different categories as follows:

1. Words "engineer" and "general engineer."

2. Words designating general field. These include members of all the major traditional engineering fields, as follows: chemical (engineer), civil, electrical, mechanical, and mining.

3. Words designating zone of interest (Table II). Such words indicate the specific structures, materials, or products to which the specialist devotes himself, or the special technology which he uses in his particular work; and the list as a whole furnishes a good general description of the varied sorts of problems which may be encountered in the domain of civil engineering.

4. Words designating engineering functions. The engineering process, carried on from the time a particular human need is recognized until the time when that need is satisfied through organized engineering effort, may be divided into a number of steps, each one of which calls for the exercise of a particular function. These functions, coordinated by engineering management, are all required in the process, no matter whether the product is an airplane or a bridge or an irrigation system. The history of civil engineering in the past century has shown not only a great increase in specialization of zone of interest, but an even greater increase in specialization of function.

Functional adjectives used to modify "engineer" are much fewer than those describing zones of interest, but are used in the titles of a much greater number of men. Since functional words are not so self-explanatory as those describing zones of interest, they should be used only when their meanings are clearly defined. The adjectives in Table III seem clearly descriptive of function.

5. Words denoting capacity in which the engineer utilizes his knowledge and skill follow: advisatory (engineer), advisory, consulting, federal, government, squad, staff.

6. Words denoting rank. The following words indicate present position held by the engineer, but are of little value in classifying the branches of civil engineering:

assistant (engineer)	first assistant	principal
associate	first deputy	provisional
chief	head	senior
deputy	junior	

7. Words describing geographical location of the engineer. These also are of little value for classification purposes. It is likely that in reality most of them are indicative of the position held by the engineer rather than of his special professional field. Words designating the geographical area in which the engineer performs his task are of only the slightest help in describing the work he does. Although such titles as "city engineer" and "division engineer" are deeply entrenched in civil engineering usage, it is strongly recommended that they be considered as part of the engineer's title of rank in an organization, and that they be replaced, in choosing a professional title, by appropriate words taken from the lists descriptive of function or zone of interest. The geographical terms found were:

area (engineer)	division	state
borough	local	town
city	parish	township
corps area	regional	U. S. area
county	resident	village
district	section	western
	shire	

8. Words describing professional status. Such words are least useful in differentiating engineers: cadet (engineer), graduate, retired, student.

A few titles were found which did not clearly fit into any one of these eight categories. Several of these strike one as being merely weird inventions which are meaningless and unnecessary, such as "company engineer," "construction paving engineer," "department engineer," "job engineer," "newspaper engineer," "progress engineer," "real-estate engineer," "sectional engineer," "sewage relief engineer," "social engineer," and "transmission construction engineer." "Special engi-

TABLE I. THE EIGHTY-NINE TITLES APPEARING MOST FREQUENTLY IN THE 1931 SOCIETY YEAR BOOK

consulting engineer	1,004	*contracting engineer*	64	*valuation engineer*	38	*vice-president and chief engineer*	23
engineer	669	*general manager*	60	*consulting civil engineer*	37	*bridge designer*	22
assistant engineer	617	*hydraulic engineer*	59	*city manager*	36	*instrumentman*	22
president	508	*office engineer*	59	*general superintendent*	36	*junior civil engineer*	22
chief engineer	506	*instructor*	57	*architect*	35	*inspector*	21
civil engineer	361	*bridge engineer*	56	*contractor*	35	*major, Corps of Engineers, U. S. Army*	21
vice-president	264	*architect and engineer*	54	*engineer in charge*	33	*assistant hydraulic engineer*	20
professor	251	*associate engineer*	54	*assistant city engineer*	32	*assistant resident engineer*	20
structural engineer	244	*county engineer*	53	*chief draftsman*	30	*construction superintendent*	20
construction engineer	180	*research engineer*	53	*senior assistant engineer*	30	*engineer of construction*	20
manager	158	*engineer and contractor*	51	*assistant division engineer*	28	*highway engineer*	20
city engineer	147	*structural designer*	51	*civil engineer and surveyor*	26	*assistant superintendent*	19
draftsman	130	*vice-president and general manager*	51	*secretary and treasurer*	26	*dean*	19
district engineer	129	*secretary*	48	*secretary-treasurer*	26	*junior highway engineer*	19
superintendent	129	*director*	46	*estimator*	25	*project engineer*	19
resident engineer	124	*principal assistant engineer*	42	*structural draftsman*	24	*president and chief engineer*	18
designing engineer	108	*general contractor*	41	*treasurer*	24	*assistant structural engineer*	17
junior engineer	108	*sanitary engineer*	41	*vice-president and treasurer*	24	*special engineer*	17
division engineer	107	*superintendent of construction*	41	*assistant civil engineer*	23	*engineering department*	16
field engineer	100	*district manager*	39	*engineering assistant*	23		
retired	93	*president and general manager*	39	*senior engineer*	23		
assistant professor	83	*president and treasurer*	38	*supervising engineer*	23		
associate professor	75						
assistant chief engineer	73						
designer	71						
sales engineer	65						

neer" is not helpful unless the specialty is named. "Technical engineer" seems highly redundant, implying that there might be such a thing as a "non-technical engineer"; and "technical-service" engineer does not make any useful distinction.

The only remaining terms are "field engineer" and "office engineer." These two terms might have been included under the geographical location list, but they are so often used in apparent contradistinction that they might seem to be a separate way of classifying all engineers. Actually, the only hint that these terms give of the work the engineer does is to suggest that he spends more or less of his time away from the headquarters of an organization. It is felt that all these terms are of very little value as part of an engineer's professional title.

TABLE II. WORDS DESIGNATING ZONE OF INTEREST OF ENGINEERS

aeronautical	*hydraulic*	*sanitary*
(engineer)	*hydro-electric*	*sanitation*
agricultural	*hydrographic*	*sewage-disposal*
airport	*irrigation*	*sewer*
architect	*land*	*sewerage*
architectural	*landscape*	*sewer-tunnel*
asphalt paving	*lighthouse*	*signal*
bridge	*lime-rock*	*smelter*
bridge locating	*locating*	*sound-recording*
building	*location*	*street*
buildings	*marine*	*street-railway*
cable	*materials*	*stress*
cadastral	*meter*	*structural*
canal	*municipal*	*subway*
cartographic	*natural gas*	*subway-ventilation*
catenary	*park*	*terminal*
cement-mill	*paving*	*timber*
cement-plant	*permanent-way*	*topographic*
concrete	*petroleum*	*topographical*
drainage	*petroleum-refinery*	*traffic*
electrical-signal	*pilot*	*transit*
equipment	*plant*	*transportation*
filtration	*port*	*underpinning*
fire-prevention	*power*	*water*
Fowler	*public-utility*	*waterways*
gas	*railway*	*weigh*
geodetic	*rate*	*welding*
grade-crossing	*reclamation*	*wire-rope*
harbor	*reinforced-concrete*	*works*
highway	*right-of-way*	*zoning*
highway-bridge	*road*	

SIGNIFICANT WORDS IN TITLES

A plan was devised which it was hoped would combine a numerical frequency listing with a word study such as that just described. Accordingly, the laborious task was performed of making an alphabetical frequency list of all significant words (omitting "and," "of," "in," and such) found in the titles given. Certain variant words from a single root were listed as a single word.

TABLE III. ADJECTIVES DESCRIPTIVE OF ENGINEERING FUNCTION

accounting (engineer)	directing	negotiating
administration	distribution	operating
analytical	erecting	planning
appraisal	erection	production
assessment	estimating	project
commercial	evaluation	purchasing
constructing	examining	research
construction	executive	safety
contracting	exploration	sales
cost	industrial	service
demonstration	inspecting	superintending
design	investigating	supervising
designing	maintenance	testing
development	managing	valuation

A total vocabulary of 432 significant words (plus their variants) was found in the titles given. These words appeared 23,694 times, making two significant words the average number for each title. These significant words were then classified according to groups of categories similar to those used in the study of adjectives modifying "engineer," and a frequency count was made of the number of times each was used in the title list.

The ten categories used, and the percentage of the total of 23,694 times that significant words for each of these ten groups were found, are given in Table IV.

This summary seems to show that words indicating zone of interest, engineering functions, capacity (mostly "consulting"), and rank are preponderant among all the types used in the engineering titles found. The low frequency of words designating general field ("chemical," "civil," "electrical," "mechanical," and "mining") reveals that the traditional scheme of subdivision is not much used by the civil engineering group; nevertheless, it would probably be useful to retain these words designating field in any classification based on professional title.

CHIEF DESCRIPTIVE WORDS

Rank is independent of function or zone of interest; it is something that comes by promotion, whereas function or zone represents the man's particular type of education and his chosen sphere of activity. The very high frequency of use of words designating rank would support the belief that this type of title should be given separately from professional title.

If this is done, it then appears that four types of descriptive words—those here termed as general field, zone of interest, function, and capacity ("consulting" or "professor")—are used predominantly, and it seems clear that all these types should be provided for in any standard scheme proposed for the classification of engineers. The remaining types of words—those here termed as "geographical location," "professional status," and "not primarily engineering"—although they may be needed,

TABLE IV. TEN CATEGORIES OF SIGNIFICANT TERMS USED IN SOCIETY'S YEAR BOOK FOR 1931

DESIGNATION	EXAMPLES	% OF TIMES ALL SUCH TERMS WERE USED
Profession, general	engineer, engineering	32.0
General field.	chemical, civil, electrical	3.0
Zone of interest	aeronautical, agricultural, architectural	12.0
Engineering functions. . .	administration, construction, design	14.0
Capacity	adviser, agent, consultant	9.0
Rank	assistant, associate, captain, chief	22.0
Geographical location. . .	area, borough, British	4.0
Professional status	apprentice, emeritus, graduate, licensed	0.6
Occupations not primarily engineering	accountant, advertising, attorney	1.9
Miscellaneous, mainly auxiliary or not clearly belonging to a previous group. .		1.5

in combination with titles of rank, to indicate a man's present position in an organization, are not greatly used at present and might well be left out of consideration in planning a system of classification of engineers by professional title.

A rapid increase in specialization of civil engineers, as shown by the analysis here given, has brought with it an urgent need to attempt to establish such a standard scheme by which recognized branches of the profession might be designated. The adoption of a good scheme would be of great practical value to engineering educators, to officers of national engineering societies, to those concerned with the licensing of engineers, and to all active engineers who themselves desire to understand the place they occupy in the structure of their profession and to inform the general public of their position in modern engineering.

TABLE V. CIVIL ENGINEERING CLASSIFICATION

List A—Fields and Zones of Interest

architectural	*highway-bridge*	*plant*
bridge	*hydraulic*	*public-utility*
building	*hydro-electric*	*railway*
cadastral	*hydrographic*	*reclamation*
civil	*industrial*	*sanitary*
concrete	*irrigation*	*sewer*
cost	*mechanical*	*structural*
equipment	*mining*	*terminal*
filtration	*municipal*	*topographical*
gas	*park*	*traffic*
harbor	*paving*	*transportation*
highway	*petroleum*	*works*

List B—Engineering Functions

appraisal	*executive*	*research*
construction	*inspection*	*safety*
contracting	*locating*	*sales*
design	*maintenance*	*service*
development	*managing*	*supervising*
erecting	*operating*	*testing*
estimating	*planning*	*valuation*

GOVERNING PRINCIPLES RECOMMENDED

From this study, the following conclusions are offered as possible steps toward the establishment of a standard nomenclature for civil engineers:

1. That all men who are primarily engaged in work of an engineering nature—applied scientists as distinguished from pure scientists on the one hand and from non-professional technicians on the other—use the word "engineer" as a part of their professional titles. Titles such as "draftsman," "designer," "estimator," and "inspector" should be reserved for the non-professional artisan. If a man is actually an engineer, it seems clear that he should use that word in his title.

2. That all engineers should make a distinction between professional title (indicating the branch of engineering to which their careers have been devoted) and present position (indicating the place and rank they occupy in an organization). At present these two kinds of title are used indiscriminately.

3. That all professional titles be composed of two types of adjectives—first, adjectives indicating special field or zone of interest, and second, adjectives indicating special function performed. These combination titles would be of such a sort as "civil research engineer" or "bridge design engineer." In certain cases, words indicating special capacity might need to be prefixed, for example, "consulting civil research engineer."

4. That in choosing an appropriate professional title, the engineer might best describe his activities by using one of the four following combinations:

a) If he is competent to practice in all branches of engineering, he should designate himself as "general engineer."

b) If he considers himself to be a specialist in all functions in a particular field or zone of interest, he should designate himself as "general civil engineer," or as "general structural engineer," "general highway engineer."

c) If the engineer considers himself to be a specialist in all fields or zones of interest in a particular function, he should designate himself as "general research engineer," "general design engineer," "general sales engineer."

d) If he considers himself to be a specialist in a certain field or zone of interest, and likewise in a certain function in that field, he should designate himself by a combination of these two types of title, such as "civil research engineer," "bridge design engineer," "highway construction engineer," and similar titles.

5. That, since most of the words descriptive of civil engineering functions are not self-explanatory, a list of definitions be composed and agreed upon to delimit the use of these terms.

The practical working of these proposals is exemplified in the classification lists which are here suggested for profession or occupation only. The adjectives in these lists should be prefixed to the word "engineer." List A or List B (Table V) may be used singly or in combination. The word "consulting" may be added before any title if required. A double title may be given, for example, "civil and mechanical engineer," "design and construction engineer," "professor and civil engineer." Adjectives in titles need not be restricted to those included in the various lists.

An additional classification may be added, according to present position or rank, for example: "Superintendent, Construction Division, ... County, St. Louis, Mo.," "City Engineer," "Assistant Professor, ... University," "Division Engineer ...... Railway."

Using only the words to be found in the lists of adjectives previously given which designate field, zone of interest, and function—each of which adjectives may be rigidly defined in small space—it is possible according to this recommended scheme to make up several thousand different combination titles that are highly descriptive. This plan of building titles from a number of interchangeable words would be flexible enough, it is believed, to permit a good classification of engineers indefinitely, since new words could be admitted to the lists when demanded to describe new functions and new zones of interest taken over by the profession.

It is considered important for scientists and engineers to classify with great care the natural objects, products, and materials which they study and handle. How much more important, then, should it be to give attention to the classification of the various types of engineers, which have had such a large part in the making of the modern world! Any attempts at this time to promote among the engineering fraternity a more logical scheme of classification of the branches of engineering cannot but lead to valuable results—in a better understanding of the logical divisions of the profession, in a clarification of the differences that distinguish one branch from another, and in a better comprehension of the qualities requisite for success in each branch.

ENGINEERS' NOTEBOOK

From everyday experience engineers gather a store of knowledge on which they depend for growth as individuals and as a profession. This department, designed to contain practical or ingenious suggestions from engineers both young and old, should prove helpful in the solution of many troublesome problems.

Passing a Curve Through a Fixed Point

By Alger C. Gildersleeve, M. Am. Soc. C.E.
Far Rockaway, N.Y.

PERHAPS few engineers charged with the determination and laying out of a circular curve to pass through a given point realize that this may be done in the field, and that the point of curvature may be determined with transit and tape without any calculation at all. This method of solution is here described. Other methods have been treated previously in Civil Engineering—by L. S. MacDowell, Assoc. M. Am. Soc. C.E., in the January 1934 issue, page 37, and by two discussers of his article, C. O. Carey, M. Am. Soc. C.E., and George H. Dell, Assoc. M. Am. Soc. C.E., in the April and June 1934 issues, respectively (pages 219 and 313).

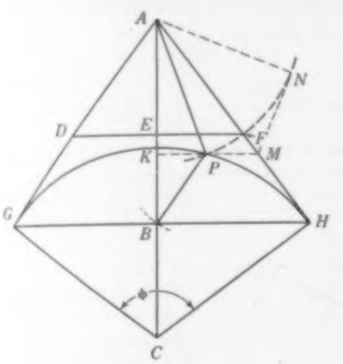


Fig. 1. A Circular Arc Described Between Two Given Tangents and Through a Fixed Point

Given the two tangents in Fig. 1, intersecting at A, and the point P, with its distance AP. Draw the isosceles triangle DAF, with AF equal to AP. Draw a line bisecting the angle DAF and intersect it so that PB equals EF. Draw GBH parallel to DF, and GC and HC at right angles to the tangents. With C as center describe the arc GH, which will pass through P.

That this is the desired arc may be proved as follows:

$$\text{By construction, } \frac{BP}{AP} = \frac{EF}{AF} = \frac{BH}{AH} \quad . \; . \; . \quad [1]$$

The equation of a circle in bi-punctual coordinates is:

$$K \text{ (constant)} = \frac{R_2}{R_1} \quad . \; . \; . \; . \; . \; . \; . \quad [2]$$

With foci at A and B, we have:

$$K = \frac{BH}{AH} \text{ and } \frac{R_2}{R_1} = \frac{BP}{AP}$$

These relationships satisfy Equation 2.

Inaccessibility of the point of intersection or obstructions in the line of sight might make the field work of determining the point of curvature with transit and tape impracticable. In this case the distance AH may be calculated as follows:

Draw KM through P at right angles to AB. Then, the length and bearing of AP being known, AK is found, and then AM. Since KM is a common secant of the two circles having respectively the radii AP and CH, the tangents MN and MH drawn from M to these circles will be equal. Next MN is calculated as the altitude of the right-angled triangle ANM, whose base, AN, equals AP, and whose hypotenuse, AM, is known. Finally, MH is laid off equal to MN, giving H as the point of tangency.

Influence Lines for Truss Obtained by Graphics

By Robert C. Veit
Assistant Professor of Civil Engineering, The Polytechnic Institute, Brooklyn, N.Y.

THESE notes explain a simple graphical method of determining the controlling ordinates to the influence lines for the members of a simple truss having one horizontal chord.

Draw the truss diagram to scale, Fig. 1(a). Below it draw the horizontal base line, yw, in Fig. 1(b), and, on the lines yL_0 and wL_8, lay off yx and wv equal to unity. Draw xw and yv. Connect the moment center for any horizontal chord member with the point L_0. For member SK the moment center is U_3. Draw L_0U_3. In Fig. 1 (b) draw bc from b parallel to L_0U_3, and from c draw cd parallel to CW. Then draw the lines dy and dw. Finally, draw bf and hk horizontally from b and h,

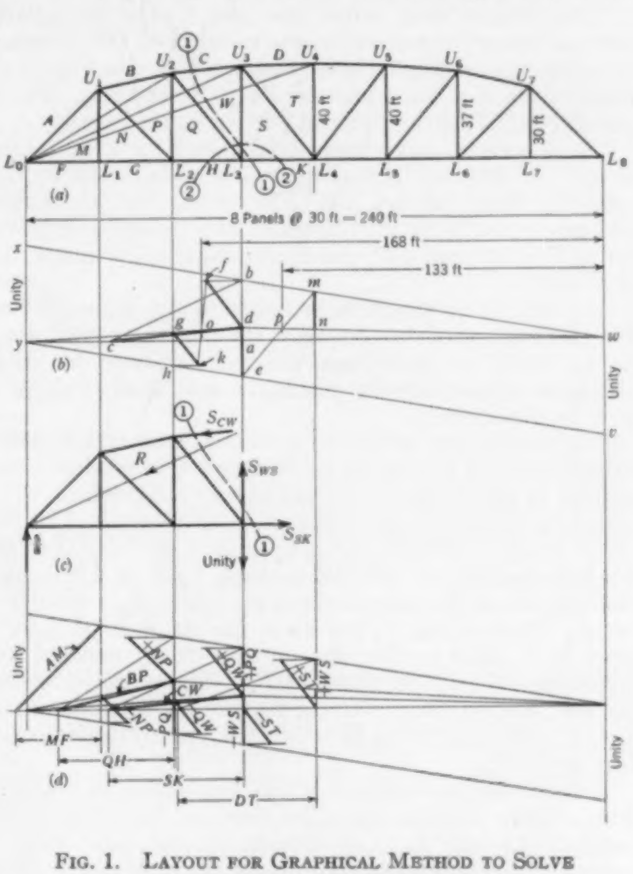


Fig. 1. Layout for Graphical Method to Solve Influence Lines of Truss

respectively, and df and gk parallel to QW. The lines ca, cd, de, mn, df, and gk are the controlling values for the members SK, CW, WS, and QW. Points o and p are the neutral points for members QW and WS, respectively.

For the truss shown, if a unit load is placed at L_3, the stresses in members CW, WS, and SK may be determined graphically by taking Section 1–1, and the stress in QW may be determined from Section 2–2. The resultant of the unit load at L_3, and the stresses in members CW and WS, passes through U_3. This resultant, which will be designated by the letter R, in Fig. 1 (c), together with the reaction of $^5/_8$ at L_0 and the stress in member SK, constitutes a system of three forces acting on the free body of Fig. 1 (c). For equilibrium, these three forces must meet at a point which is determined by the intersection of the $^5/_8$-lb reaction and the stress in the member SK. This point is L_0, and the direction of R is determined by the line drawn through L_0 and U_3.

In Fig. 1 (b), the distance ab on the vertical through L_3 is equal to $^5/_8$, by proportion, and ae equals $^3/_8$. Also, be equals unity.

Since ab equals $^5/_8$, a line drawn from b parallel to R in Fig. 1 (c) and intersecting yw at c, determines the force triangle abc, in which ca is the stress in member SK for a load of unity at L_3. Furthermore, since the horizontal component of the stress in member CW is equal to the stress in member SK, it follows that the line cd drawn parallel to CW is the stress in member CW for a unit load at L_3. The stress in WS for a unit load at L_3 is equal to de. This may be seen from the following: The stress in WS is equal to unity minus $^5/_8$ plus the vertical component of the stress in CW, Fig. 1 (c). Expressed in terms of the stress diagram, Fig. 1 (b), this is: The stress in $WS = be - ba + ad = de$.

It is evident that, when the unit load is at L_3, the vertical component of the stress in member QW is equal to unity minus the stress in member WS. In Fig. 1 (b), this is be minus de, which is db. Therefore df, drawn parallel to QW, is the stress in QW for a unit load at L_3.

These stresses have been determined for a unit load at L_3. It follows that the maximum ordinate to the influence line for member SK is ca, the maximum ordinate for CW is cd, the maximum positive ordinate for QW is df, and the maximum negative ordinate for WS is de.

The maximum negative ordinate to the influence line for QW, obtained analytically by placing a unit load at L_2, and the maximum positive ordinate for WS, obtained analytically by placing a unit load at L_4, will now be determined.

For equilibrium at joint L_3, with a load at any point other than L_3, the stress in WS and the vertical component of the stress in QW are numerically equal. The stress in WS for a unit load at L_2 is two-thirds of the stress in this member for a unit load at L_3. The line dy, intersecting the vertical through L_2 at g, determines the magnitude of the intercept gh, which by proportion is two-thirds of de. Thus gh is the stress in WS for a load at L_2 and is also the vertical component of the stress in QW for a unit load at L_2. Therefore gk, drawn parallel to QW, is the stress in QW for a unit load at L_2 and is the maximum negative ordinate to the influence line for QW.

A unit load at L_4 stresses QW four-fifths as much as does a unit load at L_3. The line dw, intersecting the vertical through L_4 at n, determines the magnitude of mn, which is, by proportion, four-fifths of db, the vertical component of the stress in QW for a unit load at L_3. It follows that mn is the stress in WS for a unit load at L_4. By definition, mn is the maximum positive ordinate to the influence line for WS.

Points o and p are seen to be neutral points for members QW and WS by direct proportion. The controlling ordinates for all the members of the truss are shown in Fig. 1 (d).

Nomogram for Finding Maximum Moment Due to Two Moving Loads

By HARRY HORELICK

PATERSON, N.J.

COMPUTATION of the maximum bending moment in a span caused by two moving loads ordinarily involves a somewhat tedious procedure. By means of the nomographic chart, Fig. 1, this calculation is made simple and rapid through the use of two values that can be readily arrived at.

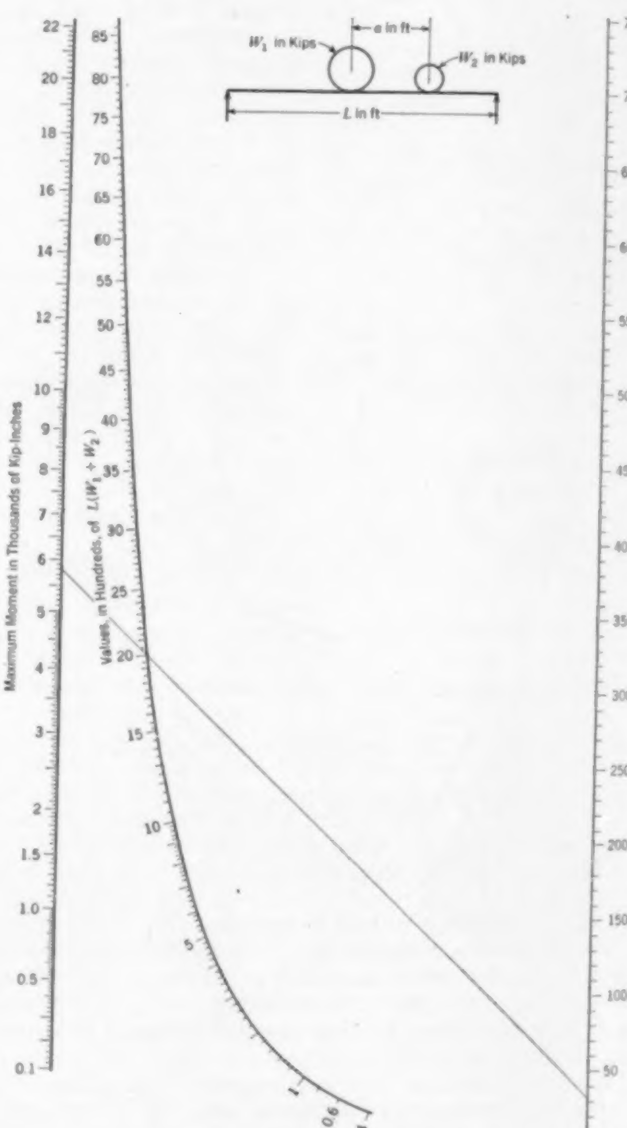


FIG. 1. MAXIMUM MOMENT DUE TO TWO MOVING LOADS

As shown diagrammatically in the inset in Fig. 1, the following terminology is used:

W_1 = larger load, in kips
W_2 = smaller load, in kips
a = distance between the two loads, in feet
L = length of span, in feet

In order to obtain the maximum bending moment in the span L, three operations are required.

Multiply a, in feet, by W_2, in kips.

Multiply L, in feet, by $W_1 + W_2$, in kips.

With a straight edge connect the value found for aW_2, on the scale at the right side of Fig. 1, with the value found for $L(W_1 + W_2)$, on the line next toward the left. The maximum bending moment, in kip-inches, is then read directly on the scale at the extreme left.

For example, assume two wheel loads of 2 tons and 8 tons, spaced 8 ft apart on a span 100 ft long. The following values will then be obtained:

$$aW_2 = 8 \text{ ft} \times 4 \text{ kips} = 32 \text{ kip-ft}$$
$$L(W_1 + W_2) = 100 \text{ ft } (4 \text{ kips} + 16 \text{ kips}) = 2{,}000 \text{ kip-ft}$$

Extending a straight line through these two values on the chart, the maximum bending moment of 5,800 kip-in. (occurring under W_1) is read at the extreme left.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Enlightening Venturi Meter Tests

DEAR SIR: Calibrations of Venturi meters in the laboratory of the Civil Engineering Department of the University of Pennsylvania throw interesting light on the paper by Messrs. Allen and Hooper in the April number.

A 12 × 6-in. Venturi meter was calibrated in May 1919. The piping arrangement was as shown in Fig. 1(a), the coefficient of discharge being 0.9767. In December 1920, this same meter was tested in its permanent position in the laboratory, Fig. 1(b). The coefficient was again 0.997, indicating no effect due to the change in installation.

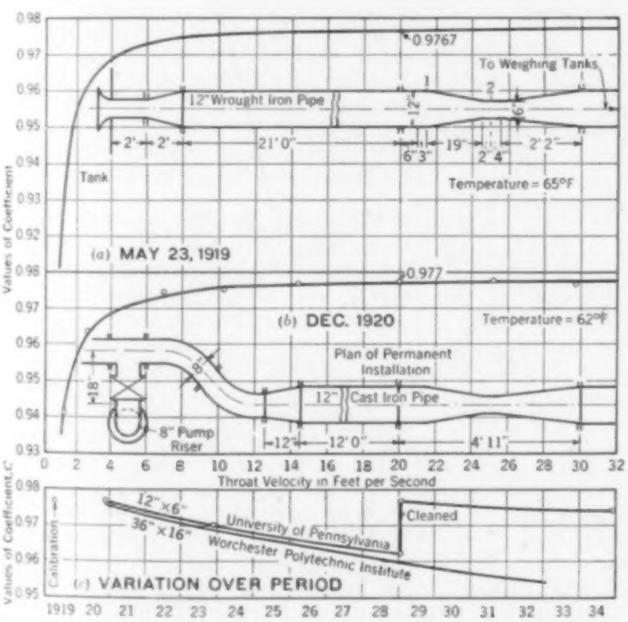


FIG. 1. COMPARISON OF VENTURI-METER TESTS
(a) Calibration 12 × 6-in. Meter, University of Pennsylvania. (b) Same Meter Installed in Laboratory. (c) Behavior of Two Meters Over a Series of Years

Successive tests, Fig. 1 (c), show the progressive falling off of the coefficient chronologically. After cleaning early in 1929, the original coefficient of 0.9775 was again obtained. As the piping arrangement was not altered and was not cleaned, it would appear that the falling off in the coefficient depended only on the meter itself. The corresponding curve for the 36 × 16-in. Venturi meter at Worcester Polytechnic Institute is also indicated in Fig. 1 (c). These curves are in surprising agreement.

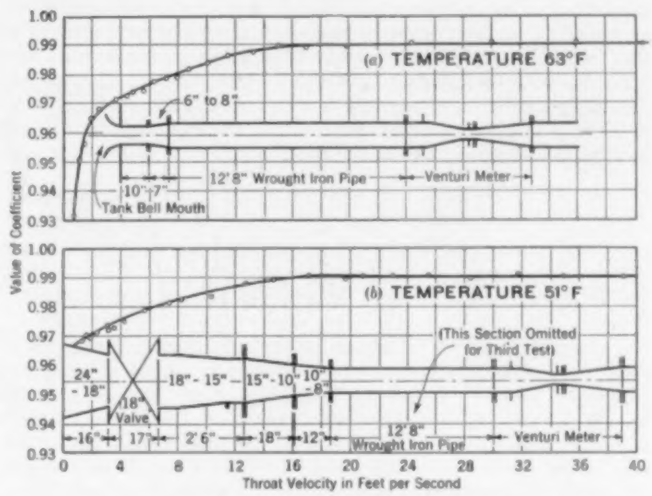


FIG. 2. TESTS OF 8.060 × 3.3759-IN. VENTURI METER TO SHOW INFLUENCE OF INSTALLATION
(a) First Test. (b) Second Test with Reducers Inserted

These experiments would seem to indicate that the approach conditions have very little, if anything, to do with the coefficient of a low ratio Venturi meter. In order to check this matter further, experiments were conducted on an 8 × $3^3/_8$-in. bronze Venturi meter; Fig. 2 (a) shows the result of this test and corresponding arrangement of piping. The pipe factor at the main section of the meter was about 0.885, and the Venturi meter coefficient was 0.99. The piping arrangement was altered as shown in Fig. 2 (b). The pipe factor in the main was about 0.89. Again the coefficient was 0.99.

Again the piping was changed, the meter being placed for the third test immediately after the series of flanged reducers, as noted in Fig. 2 (b). At the outlet of the last reducer the flow was what might be called "shooting flow" and entered immediately into the Venturi meter. The pipe factor was about 0.975. Again the coefficient of the meter was 0.99.

It would therefore seem that too much emphasis has been laid on the approach conditions of the Venturi meter, and when abnormal conditions are found it is well to examine the meter very carefully with respect to increased roughness and also the piezometer taps,

particularly at the throat. I have found a serious falling off in the coefficient of Venturi meters only when the water approaches the meter in the form of a free vortex.

W. S. PARDOE, M. Am. Soc. C.E.
Professor of Hydraulic Engineering, University of Pennsylvania

Philadelphia, Pa.
May 17, 1935

Cape Cod Canal Planned for the Future

TO THE EDITOR: The article by Lieutenant Harwood on "Proposed Improvement of the Cape Cod Canal," in the March issue, confirms the sound judgment of its planner and builder, the late William Barclay Parsons, Hon. M. Am. Soc. C.E. As a result of his foresight, the canal was built as an open channel at sea level, shortly after the decision in favor of a lock canal for Panama. It was his belief that a lock at sea level would be unnecessary.

The limited resources of a private corporation demanded the utmost economy in first cost, and it was with no delusions as to the future adequacy of a hundred-foot channel that such a width was adopted. General Parsons regarded locks as objectionable not only for the reasons mentioned, but because of the limit placed on future widening. He planned a channel that in time would be part of a coastwise route for seagoing ships. He did not believe that there was any more reason for obstructing it with a lock for current reduction than there would be for having a lock in Hell Gate for the same purpose.

Ice in Buzzards Bay was a fact, not a probability, before the canal was opened. During the winter of 1907–1908 an engineering party worked on a surface of solid ice over Monument River and Buzzards Bay along the proposed channel west of the railroad bridge, and made soundings through holes cut along the section lines as they were successively located. The original canal was only 100 ft in width for half its length, but a width of 200 ft was planned. The bridges were built for a 165-ft width of channel and for a depth of 30 ft. The first mile of the canal at the eastern end was 300 ft wide, and the five miles at the western end were 250 ft wide.

The contractors did not expect to excavate the whole project by hydraulic methods. They had two hydraulic dredges immediately available and put them to work at the eastern end, where the digging was easiest. These machines excavated most of the 300-ft channel from the Cape Cod Bay entrance to Sagamore, before encountering boulders. The cost was low. Other types of excavating machines were also used, and the delays at the start and change in type of equipment resulted from the financial situation rather than lack of information. Tidal current conditions were studied for two years before construction was started. Automatic tide-recording gages, installed near both ends of the proposed canal in 1907, were continuously in operation until the completion of the work. They were connected by a line of precise levels and gave a complete record of tidal differences for the study of probable velocities, as is shown in detail in General Parsons' paper in Vol. 82 of TRANSACTIONS.

In 1908 careful borings were made along the line of the canal, and quite complete information was available to contractors as to the nature of the material to be excavated—glacial drift.

During the construction of the Buzzards Bay railroad bridge in 1909–1910, three masonry piers were built in open-box caissons, which were floated into position and sunk in previously dredged excavations, upon a support of piles cut off to a uniform level. In the course of this excavation, which was by floating dredge during the winter, many boulders were encountered. One of these weighed as much as 90 tons, and none of the piles could be driven to any greater depth than from 15 to 25 ft. From this experience there was ample reason to expect difficulty in driving the steel sheet piling, which was used in making the excavations for the new bridge piers, recently constructed alongside the old ones.

It is gratifying to have the basic ideas of the planner and builder of the original canal justified and verified, as his work is expanded to an extent hardly conceivable a quarter of a century ago.

HENRY WELLES DURHAM, M. Am. Soc. C.E.
Formerly Resident Engineer, Cape Cod Canal

Sandwich, Mass.
May 29, 1935

Comments on National Planning

TO THE EDITOR: The article by Mr. McDonald, in the March issue, is an effective summary of the needs for a national mapping program. He points out the vital importance of the basic triangulation and precise level work of the U. S. Coast and Geodetic Survey. The extension of this work in the various states was one of the first steps taken by Congress, in November 1933, to relieve the unemployment situation among professional engineers.

The Federal Emergency Relief Administration asked the U. S. Coast and Geodetic Survey to undertake this work as part of the drive for economic recovery. It was stated that the two principal objectives were to give immediate employment to the largest possible number of engineers and others, and to have that employment result in high-grade work of permanent public value. A quota was established for each state, and field parties, labor gangs, and clerical and computing staffs were rapidly organized. Many competent engineers, who had been out of work for some time, eagerly accepted such positions of responsibility as supervisors or chiefs of party, at rates of pay far below those to which they had been accustomed in better times. The Survey directed the work through a representative in each state.

In the middle of February 1934, all the work was shifted to the Civil Works Administration, a short-lived agency, which was followed by the various state emergency relief administrations. These receive federal funds directly from Washington and disburse them within the state according to relief needs. In some states certain groups were found to be in greater need of relief than were the surveyors, so the triangulation work was stopped.

Connecticut has had the sympathetic cooperation of the State Emergency Relief Administration. In this state the fundamental character of the state-wide local control surveys, based on the work of the U. S. Coast and Geodetic Survey as first set-up, has been recognized as of prime public value. Unemployed engineers in many widely separated localities were set to work. Advice and assistance have been given to local town surveys, which have been started with relief funds. This assistance included instruction in approved methods, the calibration of tapes and instruments, and similar services.

Mr. McDonald makes the interesting suggestion that, with the increase in mapping activity which he favors, a related change be made in the curricula of engineering schools. He advocates more instruction in triangulation, precise leveling, astronomy, and geodesy. This at once raises the question, what can be left out of the already crowded four-year course to give time for such instruction? Our engineering students are given sound training in the fundamental theory of surveying operations, supplemented by summer field work which, while elementary, is basic and highly instructive. This familiarizes students with the ordinary instruments of surveying, their use, and the way in which the results obtained in the field are used in the preparation of maps. It is doubtful if it would be wise to carry formal technical instruction much beyond this point, at least for undergraduate students. To build a bridge or complete a primary survey an organization of specially trained men is needed, and this training can be obtained only through apprenticeship on actual work. Instruction given in school, including the few weeks of summer field work, puts the student in a position to absorb quickly and efficiently the details of field practice. It is only through months of such field work, supplemented by further reading and study and office experience, that one may reach the rank and dignity of a geodetic engineer.

C. J. TILDEN, M. Am. Soc. C.E.
Strathcona Professor of Engineering Mechanics, Yale University

New Haven, Conn.
May 20, 1935

Effect of Drivers' License Law on Automobile Fatalities

To the Editor: The article by Colonel Barber on "Uniform Traffic Code for Highway Safety," in the March issue, is a clear and forceful summary of important efforts that have achieved considerable success and for which Colonel Barber personally deserves much credit. However, in appraising the accomplishment of the drivers' license law in preventing deaths, Colonel Barber reaffirms a widespread error. He gives the law credit that should properly go elsewhere. He does this through failure to distinguish between urban and rural accident trends when stressing the accident decrease in the states that have license laws.

In the rural areas of such states, the control of motorists rests almost wholly with the motor vehicle department and the state police. In cities the situation is different. There the license law is a minor part of an elaborate accident-prevention program that is legal, educational, and mechanical. This program exists for the protection of both motorist and pedestrian, the principal sufferer in urban automobile accidents. The trend of fatalities in rural areas reflects the effectiveness of the license law; the urban trend does not. Yet Colonel Barber has used the state-wide trend to measure the effect of the law—even in Massachusetts, with almost five urban dwellers to each rural dweller, and in Rhode Island where the ratio is seven to one.

In a number of states (some with the license law and some without) automobile fatalities in the large cities have been almost static for years. In Table I are shown the states having standard license laws, in which fatalities in the larger cities have increased less than 10 per cent since 1926. The state-wide increase in fatalities for these states, which amounted to only 26 per cent, appears in the estimates used by Colonel Barber. As shown in the table, however, the increase in fatalities outside the larger cities was almost double this. In the rural parts of these states, the increase has been still more rapid because the available scattered statistics show the trend of fatalities of the small cities—which in the aggregate have a large population—to be similar to that of the larger cities. Accident increases in the really rural areas of these states have been terrific.

Table I. Comparison of Urban and Rural Automobile Fatality Increases in Certain States Having Standard License Laws, 1926 to 1933

State	Percentage of Increase in Fatalities in Cities of 100,000 Population and Over	Percentage of Increase in Fatalities in Remainder of State
Delaware	−3 (decrease)	167
Maryland	5	81
Massachusetts	3	30
New York	5	70
Pennsylvania	8	36
Rhode Island	−21 (decrease)	−26 (decrease)
Group of states	4	47

The decrease in urban fatalities cannot be ascribed to the state law. In Philadelphia, the automobile death rate rose 13 per cent from 1926 to 1933. During this period pedestrian deaths decreased 6 per cent, while the deaths of others (the great majority of them motorists) increased 96 per cent. Surely here is no evidence that the Pennsylvania law affected the death rate in Philadelphia. With this increase in the death rate of motorists, the drop in the number of pedestrian deaths must be ascribed largely to an increase in pedestrian carefulness and agility. We find further that the pedestrian death rate decreased because of the great drop in the number of child deaths. These declined 60 per cent, while the death rate of adult pedestrians was increasing 65 per cent. Even in cities, motorists are killing themselves and adult pedestrians at a rapidly increasing rate, but our children are learning to be careful in crossing streets. To this fact we owe what gleams of brightness there are in the automobile accident situation.

The drivers' license law can be effectively administered where public opinion demands punishment for those who cause accidents. Results of the law in Rhode Island show this. But, as ordinarily enforced, the license law deserves only a fraction of the credit it usually receives. There is a need more urgent than wider adoption of the drivers' license law. The principal need is for more effective enforcement of the law in states where it now exists.

William J. Cox, M. Am. Soc. C.E.
Professor of Engineering Mechanics
Yale University

New Haven, Conn.
May 26, 1935

City Planning as Relief Work

To the Editor: The article by Mr. McCrosky, in the April number, shows clearly that city planning can be effectively carried out by work-relief forces. However, still more should be done, and this involves overcoming certain definite obstacles that have held such work back.

One of these has been a general lack of appreciation of the scope of planning activities that can be carried forward by relief projects. In general, it is not practicable for a community to prepare a complete city plan with such a staff, but excellent progress can be made in the gathering of basic information and in other preliminary work. With such a start, official plans can be completed quickly by permanent organizations having adequate technical supervision.

Another difficulty, particularly noticeable under the CWA, was that of interesting relief officials in such small projects as city planning generally involves. However, it is now being recognized that it is more important that useful work be initiated than that a particular project employ a large number of men. Still another problem has been to find in the municipality or county an official sponsor for the project. This is particularly true where there is no planning board or where such boards have been inactive.

There is also a problem in the fact that the manual of procedure prepared by the FERA includes in its list of proposed projects no item that adequately covers city or county planning. As a result, such legitimate planning projects have been confused with what is known as "project planning," which means the preparation of a program of work-relief projects. This difficulty, which has been brought to the attention of the FERA by the City Planning Division of the Society, will undoubtedly be remedied.

During the past year it has been relatively easy to establish work-relief projects for state planning due to the fact that the National Resources Board has supplied consultants for the supervision of such projects. I believe that almost any county can make effective use of a planning project as can the largest municipalities, where local relief rolls are almost sure to obtain enough technical men to do effective work in city planning.

During the past year the Regional Plan Association in New York City has made the promotion of work-relief planning projects within the city and its environs one of its major efforts. It has just published a bulletin under the title, *Planning with Work-Relief Funds and Personnel in the New York Region*, which gives a complete survey of all work-relief planning projects carried out by official agencies within the metropolitan area under either the CWA or the state emergency relief administrations in New York, New Jersey, and Connecticut. The activities of the association have been concentrated on an attempt to secure the establishment of projects in the different counties, although about 25 municipalities have also been contacted.

New York City has under way an active planning project under the direction of the Mayor's Committee on City Planning. Of the 17 suburban counties within the area studied by the association, Orange, Rockland, Westchester, Bergen, Middlesex, and Fairfield counties have projects under way. Passaic County has one approved and ready to start, and six additional counties have sponsoring groups that have either submitted or are preparing planning projects. During the past two years 54 municipalities in this same area, through work-relief projects, have accomplished something that can be classified as actual city planning or closely related to it.

A planning project as defined in the survey takes into consideration the whole municipality or county involved, or an area large enough to encompass a community of persons having common interests. It should anticipate future readjustment of existing conditions and involve problems that are of direct concern to an official planning board. A related planning project is defined as one that yields information useful for planning, although it does not in itself imply any comprehensive organized improvement of existing conditions.

New York, N.Y.
May 29, 1935

Harold M. Lewis, M. Am. Soc. C.E.
Engineer, Regional Plan Association, Inc.

Value of Planning in Relief Work

TO THE EDITOR: In reading Mr. Cavanaugh's well-presented article on "Depression Activities in Wisconsin," in the April issue, one is strongly impressed by the remarkable results that the Milwaukee County Park Commission has obtained with its emergency relief program during the depression years. Obviously the reason for this success is the fact that carefully studied plans for each individual project were prepared well in advance of actual construction.

In the Milwaukee County work, as Mr. Cavanaugh points out, it was soon discovered that large numbers of relief workers could not be turned loose in park areas unless some provision had first been made for organizing definite work projects. The raking of leaves, cutting of brush, and so-called clean-up work of this general type soon proved to be dangerous activities as they gave promise of resulting in permanent disfigurement and damage to the parks. It is particularly interesting to note that the workers themselves did not enjoy this sort of project. They would far rather be doing something of a permanent and definitely constructive nature, even though the work be more exacting and laborious. This, it seems to me, is an important consideration, because a gang of dissatisfied workers can very soon raise havoc on any project, particularly if they are employed in our publicly owned park reservations.

The article is convincing proof of the fact that careful study and the preparation of detailed plans and estimates well in advance of the date of construction will yield rich results. Pleasing road alignments and gradients, the proper disposition and arrangement of tables, fireplaces, and garbage receptacles in picnic areas, the satisfactory location of tennis courts, and work of this general type prove difficult unless they have been given careful preliminary study.

It would be very helpful if more of the municipal, county, and state park organizations were to follow the example of the Milwaukee County Park Commission in carrying out their particular work relief activities. Better and more permanent work would result, and there would be fewer complaints from taxpayers and others about the money now being spent on work relief projects. Usually a complainant points to certain projects which obviously have been given little, if any, planning attention before the work was started. The excuse sometimes heard is that "there wasn't time to prepare any plans." When I hear such a statement, I am sorely tempted to ask why some other project wasn't undertaken instead. Good park work, which is properly planned and efficiently carried out, stands out clearly from ordinary "made work" because it is constructive whether it is carried on in years of prosperity or during periods of depression.

MELVIN B. BORGESON
Regional Officer, U. S. Department of the Interior, National Park Service, State Park Division

Bronxville, N.Y.
May 28, 1935

Corrections in Formula for Eccentric Riveted Connections

TO THE EDITOR: Errors appeared in my article, "General Formula for Eccentric Riveted Connections," in the March issue, and I wish to have the following corrections made.

In the notation adopted, "W" should read "w," and "ϕ" should be "the angle between the lines of action of T and V." To this notation, the following additions should also be made:

r_o = distance of the extreme rivet from the center of gravity of rivet group

s = resultant of T and V.

In Equations 8, 9, 10, 12, 14, 15, 16, 17, and 18, the expressions "W" and "W_n" should be changed, respectively, to "w" and "w_n" in order to make them agree with those shown in the figures.

Equation 10 should read as follows:

$$A = \frac{vhK}{\sqrt{[K + 6\,ew(h-1)]^2 + [6\,ep(v-1)]^2}}$$

FANG-YIN TSAI, Assoc. M. Am. Soc. C.E.
Professor of Structural Engineering
National Tsing Hua University

Peiping China
May 18, 1935

Analysis of Storage

DEAR SIR: The paper by Edgar E. Foster in the May issue, entitled "Valuation of Upstream Storage Reservoirs," deals with a subject that is of vital interest to all hydraulic engineers. His mathematics relating to the effect of storage is excellent. It seems to me, however, that his analysis of the value of storage is not correct and that he has overlooked an important item in the cost of steam plants, that is, fuel costs.

If the interest and operating costs of a steam plant are assumed to be 12 per cent annually, and fuel costs to be 4 mills per kwhr the value of the 900 cu ft per sec prime flow obtained from his Project B is found to be \$261,000 per annum. Capitalized at 6 per cent, this is equal to a capital outlay of \$4,350,000, as compared to the \$246,500 he credits to the project. If, in the conversion of secondary power to prime power, the latter is appraised at 5.45 mills per kwhr, and secondary power is appraised at 2.35 mills per kwhr, 5.45 mills minus 2.35 mills = a gain of 3.10 mills per kwhr.

The continuous flow of 900 cu ft per sec created by storage will yield 50,800,000 kwhr of prime power. Without storage this power would be largely lost. Let us assume that, in an average year, 50 per cent of the secondary power, of 25,400,000 kwhr, is available. The gain is then 25,400,000 kwhr (changed from secondary to prime power) times 0.00310 = \$78,740, plus 25,400,000 kwhr times 0.00545 = \$138,000, making a total of \$216,740. This value may also be stated as follows: 50,800,000 kwhr (present prime power) times 0.00545 = \$277,000, minus 25,400,000 kwhr (previous secondary power) times 0.00235 = \$60,000, giving a net amount of \$217,000. This compares with the \$157,480 stated by Mr. Foster, who further reduces his \$157,480 by 50 per cent credited to Plant A because it creates head. This should not be credited to Plant A unless both plants were originally part of a comprehensive power scheme. If plant B is an independent later development, it should receive full credit for equivalent steam capital costs plus fuel costs, as in the first case, or the full gain in kwhr as in the second case.

Capitalizing \$217,000 at 6 per cent as before, we find the value of storage to be \$3,667,000, or approximately as in the first case. A similar faulty theory affects Mr. Foster's third method of cost allocation. The value to Plant A of the storage created by Plant B cannot be affected by the power created at Plant B (which may vary from zero to 100,000 kwhr, depending only on the head available).

Exception is also taken to his statement that "the part of the annual expense for reimbursement of Project B exceeds the fixed charges of the equivalent steam capacity, which it should not do." Actually, it is the sum of fixed charges, operating charges, and fuel costs, which it should not exceed.

In its conclusions this article seems entirely misleading because each mathematical computation of the value of storage is based on a wrong premise. The paper has confused two issues: first, value of storage, which is equal to the cost of equivalent power and is a constant for the first, second, and third case; second, allocation of cost of storage, that is, the division of costs between Projects A and B may vary and depends on the purpose and relative value of the storage. The correct value of storage has not been arrived at.

B. E. TORPEN, M. Am. Soc. C.E.
Senior Engineer, Bonneville Project

Bonneville, Ore.
May 20, 1935

Function of a State Surveying Board

TO THE EDITOR: In his article on "State Surveying and Mapping Bureaus," in the April issue, Professor Dodds has clearly demonstrated the unnecessary wastefulness of the present practice of utilizing the results of an expensive survey exclusively for one project. He has pointed out that not only do various private enterprises often make maps covering the same areas but also that there is a possibility of 21 state agencies being engaged in map making without coordination and with duplication of effort. The establishment of a state surveying and mapping bureau appears to be an immediate necessity and very much in line with present conceptions of coordination of effort.

In addition to the functions outlined by Professor Dodds, such a bureau should be designed to establish, foster, and maintain a common surveying datum both for horizontal and vertical control. The importance of this for coordinating surveys is primary. Such datums exist, ready for use. The national triangulation and level nets established by the U. S. Coast and Geodetic Survey throughout the entire country provide accurate control points, the positions or elevations of which have received their final adjustment. To facilitate the use of horizontal control points the Survey has developed a system of plane coordinates for every state. The proposed state bureaus should use every means available to encourage the use of these points and the adoption of these systems. Authorized copies of the descriptions and positions or elevations of these points, together with the points established by the local control survey, should be made up on tracings, and prints should be kept ready for immediate distribution.

A skilled field party properly equipped should form a part of such a bureau. This will be primarily a maintenance party, which should visit every point at least once in four years and make any desirable changes. The maintenance party should be prepared, at a moment's notice, to transfer a point in danger of destruction. Where possible, it should also be ready to establish control points when the need arises and should effect connections to existing monumented surveys for the purpose of extending the system.

To make the results of future surveys available for public use, the bureau should, in return for the information furnished, demand from state agencies and private enterprises that permanent monuments be set at station points on their surveys, that they be adequately described, and that the coordinates or elevations be computed and returned to the bureau.

If these suggestions are followed, the bureau will then have available the following types of information:

1. Points established by the U. S. Coast and Geodetic Survey or under its direction.

2. Points established by accurate, well-monumented surveys that have been connected to the state datum by the maintenance party. Surveys of state agencies, including the state highway department, should prove a fruitful source of this type of information. Re-computation may sometimes be necessary. There may be level nets within the state that are carefully run but lack the precision necessary for control. Frequent ties to this net may develop areas of correction, enabling the establishment of contours of correction that would make this net available for precise work.

3. A third source of information would come usually from private sources or any survey source that the bureau did not review. Although valuable, such information could not be officially authorized as a base for future work.

A standard datum is essential for the permanent location of boundaries. The state of New Jersey has already recognized this fact by the passage of a law describing the computation and marking of the system worked out for it by the U. S. Coast and Geodetic Survey.

PHILIP KISSAM, Assoc. M. Am. Soc. C.E.
Assistant Professor of Civil Engineering, Princeton University

Princeton, N.J.
May 28, 1935

Presence of Grease Balls in Effluent Presents Difficult Problem

TO THE EDITOR: In his article in the March issue, Mr. Eddy has referred to the average fat content in ordinary sewage as about 53 ppm. The Massachusetts Department of Public Health determines the amount of fats in about half the samples of municipal sewage analyzed in its laboratories, and the average for 1933 and 1934 was 97 and 82 ppm, respectively. However, the question of the amount of fats, grease, or oils in sewage is a very difficult one to determine, not from the analytical standpoint, but because of the difficulty of collecting representative samples. This has been experienced particularly in determining the efficiency of oil separators at various oil refineries in the state and recently has been the source of much difficulty in determining methods of grease removal in one of the large sewerage systems where the discharge of grease and the resulting grease balls on adjacent shores have been the cause of much complaint. According to composite samples dipped from the surface, the amount of fats in this sewage, which contains an excessive amount of tannery waste, has averaged as high as 1,561 ppm, while other samples from the same sewer have been as low as 30 ppm.

For a period of years, the amount of fats in the sewage from one of the large tannery districts in Massachusetts, which is discharged into the sea has been so great as to cause the formation of numberless grease balls, varying in size from a large marble to a cantaloupe. They are particularly offensive in connection with the recreational uses of adjacent waters for bathing.

The results of the analyses of grease balls as made at the Lawrence Experiment Station show that they contain free fats, varying from about 25 to 45 per cent by weight on the dry basis. It is known that grease balls travel a considerable distance in salt water. Recently, in fact, such balls, presumably from the Boston Harbor outfall sewers, were found at an isolated point 66 miles from the harbor. It was first thought that they were the result of oil discharged from tankers, but analysis showed that one of the samples contained 1.13 per cent kjeldahl nitrogen, indicating that it was of sewage origin.

This grease-ball question places a new burden on engineers designing deep-sea outfall sewers. As has been pointed out, some form of treatment for the removal of floating matter and limited quantities of sludge is increasingly necessary before discharging sewage into the sea even where ample dilution is available.

In a recent investigation I have been concerned with experiments on the removal of fats and grease from one of the larger sewerage systems in the state. In this aeration at an average rate of about 0.18 cu ft of air per gallon of sewage, followed by a 7-min period of quiescent sedimentation, continuous flow, and treatment with salt and chlorine, was tried. The sewage in these experiments contained fats, varying from about 30 ppm to 124 ppm, and the amount of fats removed by plain sedimentation and sedimentation after aeration varied from 56 to over 80 per cent. Ten samples of sludge from the various experiments contained an average of 16.2 per cent of fats on a dry basis.

Although not yet conclusive, the experiments have shown that generally between 50 and 60 per cent of the fats present in heavy sewage can be settled out and skimmed from the surface with a detention period equivalent to about 7 min. The experiments did not indicate that aeration of the sewage itself is of much value, but they did show that a considerable portion of the fats in certain sludges can be removed by aeration. Thus it appears probable that some form of aeration of the sludge is desirable to remove the lighter fatty matters that may come to the surface of the harbor into which the sewage is discharged.

EDWARD WRIGHT, M. Am. Soc. C.E.
Sanitary Engineer, Massachusetts Department of Public Health

Boston, Mass.
May 22, 1935

The Hoover Dam?

TO THE EDITOR: Has the official title of the dam at Boulder Canyon ever been changed?

It is seldom that engineers receive honors or even recognition for their achievements in the profession during their lifetimes or thereafter. When the name of an individual has been given to, or inscribed on, an engineering structure, it is in bad taste and often humiliating to attempt to change or remove the name.

Witness the fact of the removal of the name of Jefferson Davis, Secretary of War, from the Cabin John Bridge near Washington, D.C., and the subsequent restitution of the inscription to its proper place. The title of the fine article on page 352 of the June number of CIVIL ENGINEERING has provoked this protest. It would seem that engineers and the publications devoted to the engineering profession should miss no honorable opportunity to perpetuate such rare honors.

HUNTER MCDONALD, Past-President, Am. Soc. C.E.

Nashville, Tenn.
June 8, 1935

(*The name was officially changed to "Boulder Dam" by order of the Secretary of the Interior, issued on May 13, 1933.—Editor.*)

SOCIETY AFFAIRS

Official and Semi-Official

Sixty-Fifth Annual Convention at Hand

Notable Program Attracts Members and Guests from All Over the Country to Los Angeles

For civil engineers all roads are leading to Los Angeles, where the Sixty-Fifth Annual Convention of the Society is about to be held, the date being July 3–7, 1935. For months the preparations have been going forward and committees have perfected all the details with the intent of serving the needs of every visitor.

Plans for the physical comfort and mental stimulus of every one in attendance have been assured. The Ambassador Hotel is planning to offer its full facilities in making the material surroundings suitable for a successful gathering. Authors of papers and addresses have prepared a valuable as well as enjoyable program. Details of reception and registration have been worked out to the last item. Plans for the many and varied excursions are completed. Then there is a splendid committee of ladies, who are leaving no stone unturned to guarantee a pleasant stay for the women guests at the Convention.

It is hard to see in what way more care could have been taken to make sure of a few delightful days in southern California. Local members in large numbers are known to be planning to support this meeting with their accustomed loyalty. Their efforts are being seconded by others within reasonable traveling distance. Finally, a group from the Middle West and the East has been enjoying a very worth-while trip of scenic and engineering interest en route to Los Angeles. About twenty enjoyed the special facilities provided for traveling together and visiting the scenic spots of Colorado, of southern Utah, and finally, around Boulder Dam.

As this issue is published, the members are already beginning to gather. The local committees are in readiness, and the Board of Direction is holding its regular session prior to the Convention itself, with special dinners, entertainments, and receptions through the hospitality of local members.

Only those who are fortunate enough to be within easy reach of this Convention or have been forehanded enough to make the necessary definite plans for attending—only these can fully avail themselves of the considerable opportunities of the Los Angeles Convention. Certain of the technical details, however, will be brought to the attention of every member, with as much success as is physically possible, when the abstracts of the papers are issued in Civil Engineering, prospectively in the September number.

Return of Professional Record Form and Questionnaire

Announcement was made in the June issue of Civil Engineering that on May 15, 1935, two forms had been mailed from Society Headquarters to all members resident in the United States. One, the biographical and professional record form, is for use in the classified file having reference to all members. The other was a questionnaire sent out in anticipation of a demand for engineers on the 1935 federal works program.

The number of questionnaires received to date is particularly significant in view of the fact that they were to be returned by only those members who were not suitably employed, or who were unemployed, and thus available for immediate engagement either as employees or consultants.

For the first few days the mails returning these forms to Society Headquarters were quite heavy but now have tapered off to an average of ten a day. Approximately 1,250 have been returned to date, which is considered to indicate a very favorable situation as regards employment among members of the Society. In order that these returns may be truly representative, members to whom they apply are urged to fill out the forms in accordance with instructions and return them at once if that has not already been done. It is evident from the letters received with many of the questionnaires that members are taking great pains to respond exactly in the spirit in which the inquiry was made.

The office procedure in dealing with the questionnaires may be of interest. Each questionnaire is stamped with the date of receipt, and an entry is made for it in a card index of names. At the same time, all material previously in the professional record file with reference to that particular member is assembled and filed with the questionnaire, so as to be readily accessible. The questionnaires would be of no value if the specialties indicated by each member were not listed in an alphabetical index, and it has been possible to keep this indexing up to date on cards as fast as the forms have been received. This index of specialties is arranged under the headings printed on the forms, and other appropriate catch-words are added as needed. Both the name and the specialty cards show the name of the member, his serial number (used for filing), and the state and city in which he lives. The last item is of especial importance if the expected inquiries limit the selection to a definite territory.

As soon as a request comes to the office for an engineer skilled in a certain field of work, and living in a particular area, it is a simple matter to locate in the subject file the cards for such men. The questionnaires and other material for these men are then examined, and copies are made of the information on the face of the questionnaires, to be forwarded to the client. A note is placed on the file copy of each questionnaire to show that this has been done, giving the date.

Although no extensive use of this file has yet been made, already it has served in connection with four inquiries and it is hoped that, with the launching of the federal works program in the near future, these records will be the means of supplying, on a large scale, information about the potentialities of Society members, and that this will bring about many professional engagements.

Local Sections Take Active Interest in Proposed Legislation

With their background of technical knowledge and professional standards, engineers are peculiarly well fitted to play an active part in undertakings for the practical benefit of their fellow citizens. From California comes word of the initiative taken by the Los Angeles Section in connection with pending legislation having to do with the proper construction and repair of school buildings.

Since March 1933, the act known as the Field Act, or the "Safety of Construction of Public School Buildings Act," has been in effective operation in California, under the control of the State Division of Architecture. Although under this set-up about five hundred school buildings have been built or rebuilt to resist earthquake shock, most of the work still remains to be done. Then in the spring of 1935 two bills affecting the conduct of the undertaking were introduced in the state legislature—one in the assembly and one in the senate.

Believing that if either of these bills was passed the work of reconstruction would be seriously hampered, and the effectiveness of the Field Act largely nullified, the Section's Board of Directors authorized its secretary to send a mimeographed letter to all members of the Section urging them to write to the committees concerned and explain why the bills were undesirable from the standpoint of safety and efficiency in school construction.

This is an example of the sort of influence that engineers can exert for the public good and to maintain their own prestige. The Philadelphia Section recently took a similar action in lodging an effective protest against a bill amending the Pennsylvania act for the registration of architects and imposing needless restrictions on the practice of engineers in preparing plans and specifications and in obtaining building permits.

Constitutional Amendments Under Consideration

Changes Relating to Membership, Dues, and Nomination of Officers to Be Considered at Los Angeles Convention

EARLY in June two amendments to the Constitution of the Society were submitted to members by letter for their information, prior to formal presentation at the Annual Convention in Los Angeles on July 3. The first series of proposed changes is basic, affecting the designation or qualifications of all grades of membership; the second aims toward a more convenient method of publicity for Society news to members and hence deals with machinery rather than with fundamental structure.

Members will recall that the procedure for changing the Constitution is set up to ensure a deliberate series of steps, of which the notice recently sent to members is one of the earliest. Proposed amendments must have been received in writing not less than sixty days before the Annual Convention, with the signature of not less than thirty corporate members. They are then submitted in printed form to members at least twenty-five days prior to the Convention. There they "may be amended in any manner pertinent to the original amendment by majority vote." The resulting form is sent out to the Society membership for letter ballot, to be counted at the first regular meeting of the Society in October.

Amendments become operative thirty days after adoption; hence the insertion of the date, November 15, 1935. If the procedure follows the normal routine, as contemplated by the Constitution, and without reference to a committee, the changes, if approved, will become effective during this calendar year.

It is assumed that all members have studied the amendments themselves and the explanatory statements which accompanied them. Inasmuch as these changes will have, sooner or later, a definite bearing on the status of every member, it is important that they be thoroughly understood. For the benefit of those who have failed to follow this development, and as a matter of record, the official amendments as proposed are listed here, together with the accompanying explanatory statement designed to apprise members of the purpose and effect of the proposed changes. The list of corporate member endorsements is not included, as they have already served their purpose in instituting the amendment procedure.

Proposed Changes in Membership Grades

The following changes are proposed in the provisions for membership and dues:

"*Amend Article II—Membership*

"Amend Section 1 by changing the second and third sentences to read:

" 'The Corporate Members shall be designated as Fellows and Members. There may also be connected with the Society, Honorary Members, Affiliates, Junior Members, and Student Members, who shall be entitled to all the privileges of the Society, except the right to vote and to hold office therein; provided that Honorary Members elected from the Corporate Members of the Society shall retain their right to vote and to hold office.'

"The Section as amended will then read:

" '1. A Corporate Member of this Society shall be a Civil, Military, Naval, Mining, Mechanical, Electrical, or other professional engineer, an Architect, or a Marine Architect. The Corporate Members shall be designated as Fellows and Members. There may also be connected with the Society, Honorary Members, Affiliates, Junior Members, and Student Members, who shall be entitled to all the privileges of the Society, except the right to vote and to hold office therein; provided that Honorary Members elected from the Corporate Members of the Society shall retain their right to vote and to hold office.'

"Strike out Sections 2 and 3 and substitute the following:

" '2. After November 15, 1935, Fellowship in the Society shall be confined to persons who have become notable in the practice of engineering. After November 15, 1935, a Fellow, at the time of his admission to that grade, shall have been a Member of the Society for not less than ten years and shall have been engaged in the active practice of his profession for not less than twenty-five years and for at least ten years thereof shall have been responsibly engaged in work of substantial importance requiring engineering ability of a high order. The Board of Direction, by not less than an 80% vote of the entire Board, may waive the requirements as to membership and length of experience, and elect an engineer to the grade of Fellow on the basis of exceptionally distinguished achievement.'

" '3. A Member, at the time of his admission, shall have had responsible charge of work as principal or assistant for at least one year, and shall have been in the active practice of his profession for at least eight years, and shall be not less than twenty-seven years of age.'

"Renumber Section 6 as Section 5.

"Renumber Section 5 as Section 6, and amend by inserting the word 'Fellow' before the word 'Member,' and changing the term 'Associate Member' to the term 'Affiliate,' making the Section read:

" '6. Any person having the necessary qualifications prescribed in this Article to entitle him to admission to the grade of Fellow, Member, or Affiliate, shall be eligible for such membership, though he may not be practicing his profession at the time of making his application.' "

"Amend Section 7, paragraph 1, by changing the term 'Junior' to 'Junior Member' in the first sentence, and striking out the word 'Associate' before the word 'Member' in the second sentence, making the Section read:

" '7. A Junior Member, at the time of his admission, shall have had active practice in some branch of engineering for at least four years, or he shall have been graduated in engineering from a school of recognized standing. He shall be not less than twenty years of age, and his connection with the Society shall cease when he becomes thirty-three years of age unless he be previously transferred to the grade of Member.

" 'Persons who were in the Junior grade prior to March 4, 1891, shall not have their status changed by the provisions of this Section.'

"Strike out old Section 9, renumber Section 8 as Section 9, and insert new Section 8, to read:

" '8. A Student Member shall be a regularly enrolled Junior, Senior, or graduate student in an engineering school of recognized standing. His connection with the Society shall cease when he ceases to be an enrolled student.'

"Renumber Section 11 as Section 12 and add new Section 11, to read:

" '11. On November 15, 1935, all Members who have held that grade for ten years and who have had twenty-five years of active practice, shall be termed Fellows; Associate Members shall be termed Members; and Juniors shall be termed Junior Members. For a period of two years following November 15, 1935, any Member may apply without endorsers to the Board of Direction for transfer to the grade of Fellow, and the Board, after satisfying itself of the applicant's qualifications, may transfer him to that grade by not less than an 80% vote of the entire Board. On and after November 15, 1937, transfer to the grade of Fellow shall be upon application favorably endorsed by seven Fellows and approved by not less than an 80% vote of the entire Board or as provided in Article II, Section 2, for recognition of exceptionally distinguished achievement.'

"*Amend Article IV—Dues*

"Strike out Sections 1, 2, and 3 and substitute the following:

" '1. The entrance fees payable on admission to the Society shall be as follows: by Fellows, thirty dollars; Members,

twenty-five dollars; Affiliates, thirty dollars; Junior Members, ten dollars; Student Members, no entrance fee.

"'2. The annual dues payable by members, except those in District No. 1, shall be as follows: by Corporate Members, twenty dollars; Affiliates, twenty dollars; Junior Members, ten dollars; Student Members, three dollars.

"'3. In District No. 1 as hereinafter constituted, the annual dues, except for members residing outside of North America, shall be as follows: Corporate Members, twenty-five dollars; Affiliates, twenty-five dollars; Junior Members, fifteen dollars; Student Members, five dollars.

"'Members residing outside North America shall pay annual dues as follows: by Corporate Members, twenty dollars; Affiliates, twenty dollars; Junior Members, ten dollars; Student Members, three dollars.'

"Strike out Section 6, and renumber Section 7 as Section 6."

Comments on Proposed Changes in Membership

"A primary objective of the amendment is to adopt membership grade terminology which will be uniform in all the Founder Societies, in accordance with the suggestion of the Engineers' Council for Professional Development.

"It is proposed to change the designation Associate Member to Member, and to establish the grade of Fellow.

"This proposal has been the subject of three reports to the Board made by a special committee of Board members appointed to give the matter special consideration. The successive reports have dealt with the effort to make the change an equitable one to all who are now Members or Associate Members and yet to establish the grade of Fellow as one highly selective in character. The definition of a Fellow appears in Section 2 of Article II, and the method by which present Members or Associate Members may become Fellows is provided for in Section 11 of that Article. These two Sections may well be studied in sequence.

"Essentially a Fellow is to be one who has 'become notable in the practice of engineering' as having been 'engaged in the active practice of his profession for not less than twenty-five years and for at least ten years thereof shall have been responsibly engaged in work of substantial importance requiring engineering ability of a high order.' This grade and designation is to be open to both present Members and Associate Members who have been Corporate Members of the Society for not less than ten years. However, provision is made whereby the Board of Direction may waive portions or the whole of the requirements as to membership and length of experience, in the election, including transfer, of an engineer to the grade of Fellow on the basis of exceptionally distinguished achievement. Thus is the newly designated grade of Fellow defined.

"The manner in which the change, as it relates to present Corporate Members, is to be effected, is prescribed in Section 11 wherein provision is made for a two-year transition period, as follows: (a) When the amendment takes effect all present Members who have held that grade for ten years and who have had twenty-five years of active practice shall *automatically* become Fellows. (b) At that same moment all Associate Members *automatically* are to become Members, the definition of that grade to remain as now prescribed for Associate Member. (c) Within two years those now Associate Members may demonstrate, without endorsers, their eligibility for transfer to the grade of Fellow. (d) Thereafter for transfer or admission to the grade of Fellow, compliance with the terms of the definition, and favorable endorsement by seven Fellows will be required.

"The term Associate Member, in effect, is a misnomer. When one has had responsible charge of work as principal or assistant for at least one year, and shall have been in the active practice of his profession for at least eight years and shall be not less than twenty-seven years of age, it is the thought that he should not be termed as one who is associated with members of his national society but that he and others with similar qualifications should be the members of that society, without qualifying or modifying adjective. The spirit back of this proposed change, therefore, is to accord membership in the Society, without disparaging designation, to those who have qualified with a definition comparable to that required by most state registration laws as a requisite to the practice of engineering. At the same time, as has been said, it is proposed to provide in the term 'Fellow' a designation befitting those men of longer practice and the attainment of recognition by their associates as notable in that practice. It is a designation, recognized in this country and abroad as denoting the highest grade of professional membership.

"It is proposed to change the name of Junior to Junior Member and to institute a new grade, Student Member.

"The proposed change in designation from Junior to Junior Member is not of moment. Rather it is a matter of being consistent. One who now describes himself as 'a Junior in' the Society would then speak of himself as 'a Junior Member of' the Society.

"The proposed new grade of Student Member is again partly a matter of conformity with the other Founder Societies, but also a definite admission to membership in the Society of those civil engineering students who wish to affiliate themselves individually with the Society to mutual advantage.

"To students who have advanced to their Junior or Senior grade with the serious intention of entering the profession, it is believed by the proposers of the amendment that the extension to them of most or all of the Society's publication privileges will be both a benefit to them and a means of individual contact that will lead them to a lifelong recognition of the Society as the professional society representative of the branch of the profession in which they are to practice. It is anticipated that the dues to be charged Student Members will not result in full offset to the increased expenses to any greater extent than present dues of other members now meet the full expenses of the Society's operations.

"Changes in Articles or Sections Essential to Consistency.

"The article relative to dues is unchanged except to incorporate the proposed new designations and to provide for the proposed Student Members. The present provision in Article II relating to former "Fellows" has been deleted. They were persons who made special financial contributions to the Society years ago. The provision relating to those who were Juniors prior to March 4, 1891, is retained since to omit it would make certain features retroactive, a procedure that is not desirable."

Proposed Revisions in Election of Officers

"Amend Article VII—Nomination and Election of Officers

"Amend Article VII, Section 6, second paragraph, by striking out the words: 'printed in the first number of the "Proceedings" issued to the membership after October 15 in each year, and substituting therefor the words: 'published within thirty days after October 15 of each year.'

"The paragraph will then read:

"'The Secretary shall prepare a list of "Official Nominees" showing thereon the name of the person nominated as herein provided for the office of President and the results of the "second ballot" which list shall be published within thirty days after October 15 of each year.'"

Basis for Change in Election of Officers

"The Society's Committee on Publications, for some time has had in mind, that when other changes in the Constitution were proposed it would suggest also a change which would permit the omission of the list of official nominees for the offices of the Society from 'Proceedings,' as now definitely prescribed by the Constitution.

"The list is now printed twice, in 'Proceedings' and also in 'Civil Engineering,' since that latter publication has become the medium for disseminating Society news to the membership. If omission of printing in 'Proceedings' were permitted this would become a publication devoted to technical papers and discussions without the introduction of any matter of different character."

When Queen Victoria Entertained

REMINISCENCES OF THE THIRTY-SECOND CONVENTION OF THE SOCIETY IN LONDON, JULY 1900

BY ALFRED E. KORNFELD, AFFILIATE AM. SOC. C.E.

THE ACCOUNTS of the Silver Jubilee of King George and Queen Mary of England, recently commemorated, may remind certain members of the Society of a series of events that took place in somewhat similar surroundings thirty-five years ago when they were entertained by Queen Victoria, grandmother of the present king.

In July 1900, I was one of a group of American engineers in vacation mood enjoying the hospitality of the Institution of Civil Engineers, with headquarters in London. The occasion was the Thirty-Second Annual Convention of the Society. The American guests assembled in the Institution library, where they were welcomed by Sir Douglas Fox, its president, on behalf not only of his own organization but also of three other English organizations, the Institution of Mechanical Engineers, the Institution of Electrical Engineers, and the Iron and Steel Institute. Fitting response was made by the late John F. Wallace, in his capacity as President of the Society. There followed a round of several days of visits and receptions, such as engineers are seldom privileged to enjoy. In particular, there was a visit to Windsor Castle as personal guests of Queen Victoria, an occasion of importance even for British engineers.

FOUR GENERATIONS OF THE BRITISH ROYAL FAMILY

Queen Victoria, King Edward, King George, and the Prince of Wales, Photographed at About the Time of the Society's Visit to London

GUESTS OF THE QUEEN

Members of the Society and other guests were taken on a special train over the Great Western Railroad from London to Windsor Castle. The equipment of this train was more than elegant—it was luxurious. Although it was not a long trip the journey was memorable. Tea was served, with peaches, which were then considered a great delicacy as they were selling in London at a very high price. Even the locomotive was noteworthy; it was the first of a new type of Great Western engines—a monstrous affair with a huge boiler and Belpaire firebox.

By good fortune, Queen Victoria was in residence at Windsor at the time. Under such conditions it was very unusual for guests to have the freedom of this great estate and to wander at will through the rooms and chapels without being conducted by a guide. This privilege however was accorded to our party by the Queen, who also ordered refreshments to be served in the Orangery. It was called a breakfast by the English but to American eyes it seemed more like an elaborate luncheon.

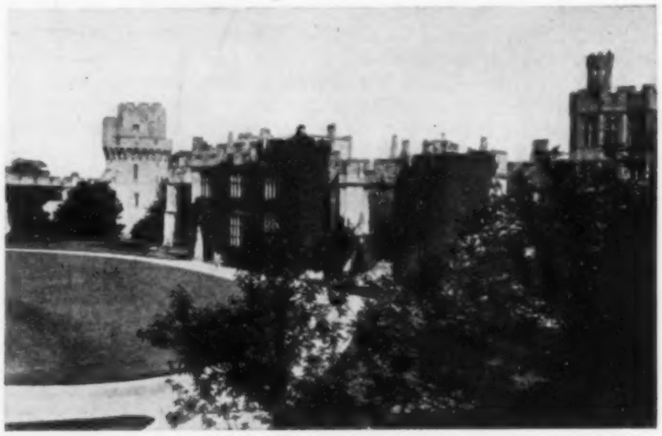
At the conclusion of this excellently served meal, Queen Victoria appeared among the guests. Sir Douglas Fox, president of the Institution of Civil Engineers, was presented to the Queen by Lord Edward Pelham Clinton, master of the household. In turn, Sir Douglas then presented to the Queen, Sir William Preece, K. C. B., a former president of the Institution, and President Wallace, representing the Society. The Queen was simply dressed in a black gown and black bonnet. Like all the English royal family, she appeared most democratic. It was with genuine cordiality that she addressed the guests, saying, "I hope you have been very comfortable. It has been a very fine day and I am pleased to see you here." In reply, the "Yankees" gave three lusty cheers and a "tiger." Her Majesty seemed highly amused at the latter and commented favorably when its meaning was explained to her by one of her retinue.

CEREMONY AT THE GUILDHALL

Another social event of considerable importance was scheduled for the evening of July 5, when a reception was given for the delegates at the London Guildhall, by permission of the Lord Mayor. This historic building was specially decorated for the occasion. For several blocks before reaching it the guests walked on carpeted lanes, and the stairway leading to the famous old hall was similarly carpeted. According to ancient custom, as each delegate arrived he was escorted to the center of the hall by an attendant, who in stentorian tones introduced him to Sir Douglas Fox, to the Lord Mayor of London, and to the citizens of the city assembled in the great room. Applause greeted each name. In fact the warmth of the greeting was distinctly embarrassing to most of us, who were hardly prepared for such public

WINDSOR CASTLE FROM ACROSS THE THAMES

Scene of the Visit of Members of the Society as Guests of Queen Victoria



HISTORIC WARWICK CASTLE FROM WITHIN THE GROUNDS

Here the Society Was Entertained by the Earl and Countess of Warwick on July 6, 1900

acclaim. In the hall the string band of the Royal Artillery played. In the adjoining council chamber pupils of the Royal Academy of Music presented a splendid concert. Vocal selections were also provided in separate gatherings in the library and art gallery.

All in all, this was a most thrilling experience, not alone for its unusualness to Americans but because of the atmosphere of the Guildhall, which lends itself especially to functions of this character.

RECEPTION AT WARWICK CASTLE

When the Countess of Warwick heard that the Institution of Civil Engineers wished their American friends to visit Warwick Castle, she told Sir Douglas Fox that they should come by all means and that she would be glad to receive them herself and entertain them as guests at luncheon. As a result, on July 6 a special train left Paddington Station for Warwick. The visitors were received by the Earl and Countess and were conducted through the castle, including all the private apartments, by the latter. Both were present at luncheon and spoke a few words of welcome. They dwelt on the importance of promoting good feeling between Britain and America. After a very delightful visit to this famous castle and gardens, the party left for Stratford-on-Avon.

These and many other examples of English hospitality made a lasting impression on the visitors. The signal cordiality shown will long be remembered as an example of professional comradeship extending across the sea. It is particularly appropriate to call it to mind at this time, on the thirty-fifth anniversary of the London Convention.

First Returns on National Survey of the Profession

IN SOME quarters there have been occasional misconceptions of the purpose of the survey of the engineering profession now being made by the Federal Bureau of Labor Statistics. Some engineers have been under the impression that the return of the questionnaire would act as the filing of an application for work under the Federal $4,880,000,000 work relief bill. This misunderstanding may have been added to by the Society's own questionnaire, mailed May 15, to find out how many of its members were available for federal public works jobs if opportunity offered.

The survey of the engineering profession being conducted by the Federal Bureau of Labor Statistics with the collaboration of the American Engineering Council, is solely for the purpose of obtaining reliable statistics on the status of the engineer in the United States. The statistics will be of great value in planning to aid engineers who are misplaced or out of work. The data will be valuable at the present time and even more so as a basis for plans for the next few years.

Any engineering project should be based on a proper survey of the conditions that obtain. A project to improve the condition of the engineer should be based on a similar survey and here it is.

On June 20 the Bureau of Labor Statistics advised that 58,000 questionnaires had already been returned. Considering that the first mailings from Washington took place about May 20, the returns to date are extremely gratifying. A return of 33 per cent in four weeks may be expected to augur close to 50 per cent by July 8, the closing date. Furthermore, spot checks for geographical distribution, range of salaries, kinds of employment, and education indicate excellent distribution in the returns so far received.

A member of the Society's staff went to Washington recently to consult with the Bureau as to the tabulations that are to be made. While the exact details are not finally settled, it can be said in general that all the information in the questionnaire will be transferred to punched tabulating cards. The Bureau of Labor Statistics has devised code systems by which this information can be recorded by punching on a card $3^1/_4$ by $7^1/_4$ in. Once punched, the cards are fed through sorting machines, which can be set to count any particular item desired. Correlations can be established at will, such as "How many civil engineers, graduates of a college with a bachelor's degree, are employed by municipal governments?"; or "How many mechanical engineers working for the federal government are under civil service?" The Bureau is planning a series of such correlations according to states, and is selecting for the first tabulations the correlations which could be of greatest immediate value. There is considerable congestion at the Bureau because of the great demand for statistics on other employment situations, but it is now anticipated that the results should be available early this fall.

One very interesting fact regarding the individual questionnaires is that almost all engineers signed their names, thus enabling apparent discrepancies to be straightened out and other necessary editorial work to be done by correspondence. The questionnaires received to date have been completely filled out, and it is anticipated that the resulting statistics will be authoritative.

Any engineer who has not received a copy of the questionnaire should take immediate steps to secure a copy directly from Andrew Fraser, Bureau of Labor Statistics, Washington, D.C., and return it at once to the Bureau.

Don Johnstone, Jun. Am. Soc. C.E., Joins Society Editorial Staff

IN ADDING one more engineer to its technical staff at Headquarters, the Society is enabled to expand somewhat its service to the membership, particularly through the medium of publications. The newcomer is Don Johnstone, Jun. Am. Soc. C.E., who comes from Kansas City, Mo. He is a graduate of the University of Illinois in the class of 1931 and is therefore a product of one of the largest and most active Student Chapters of the Society.

Counting a year and a half of work which he was able to complete before graduation, Mr. Johnstone has had over five years of excellent engineering experience. Four years of this in all has been with the U. S. Engineer Office in its Kansas City branch, which he is now leaving for his new work. For almost a year he was with the Bureau of Reclamation and for six months with the U. S. Waterways Experiment Station at Vicksburg, Miss.

Besides his specialty of hydraulic engineering, to which he has devoted over half of his professional practice, he has shown considerable aptitude in technical writing. During his senior year he was editor of the *Technograph*, the undergraduate engineering magazine of the University of Illinois. In the course of his work at the U. S. Waterways Experiment Station at Vicksburg during 1933, he was active in preparing the various technical papers then current in the extensive program of that laboratory. It is expected that Mr. Johnstone will follow up his interest in editorial work as he assists in getting out the various Society publications, with which he is already familiar through several years of study and contact.

Besides being a member of the Illinois Student Chapter, he was chosen for membership in the honorary society, Tau Beta Pi, and in the honorary civil engineering fraternity, Chi Epsilon. Also during his senior year he received the Baker award, named in honor of Ira O. Baker, for years a beloved professor at Illinois, which was bestowed on him for general excellence in his college and extracurricular work and as a tribute to his personal characteristics.

It is believed that in his new work Mr. Johnstone will find continuing usefulness and service, in keeping with the promise of his training and brief professional practice.

Employment Representatives Appointed by Local Sections

IN THE JUNE number of CIVIL ENGINEERING it was announced that letters had been sent to the presidents and secretaries of Local Sections suggesting that members be appointed to act as personal correspondents for handling information in connection with the possibilities of employment of engineers on federal relief work. Similar action was taken by the other national engineering societies.

It is gratifying to report that the response to this letter was immediate. To date representatives of the Founder Societies have been appointed in the larger centers in 38 states. The total number already appointed is 156, of which 30 per cent are representatives of the American Society of Civil Engineers.

While there has been no occasion to call on these appointees as yet in dealing with opportunities for engineers under the federal works program, the organization stands ready to assist if and when such opportunity arises. It is expected that in a short time representatives for the entire country will be named. Also it is hoped that these representatives will soon have an opportunity to render assistance in connection with engineering appointments.

Work of Engineering Functional Units Outlined

Abstracts of Addresses Delivered at May 20th Meeting of National Engineering Societies' Joint Organizations

United Engineering Trustees, Inc.

By Harold V. Coes, President, United Engineering Trustees, Inc. Manager, Industrial Department, Ford, Bacon and Davis, Inc., New York, N.Y.

The United Engineering Trustees, Inc., entered 1934 with its budget stripped of all operating expenditures that could be postponed. Some of the active problems facing the trustees included: (1) meeting occupancy competition from other buildings, which necessitated a study of the condition of the Engineering Societies Building, certain replacements and repairs being inevitable; (2) as trustees of funds, the income of which provides for active research, they had the great responsibility of obtaining an income while maintaining the security of the principal; and (3) in an effort to help the Founder Societies and their associates, they had to continue the rebates in occupancy assessments, reduce budgets below the minimum of necessary operating costs, and keep expenses within these budgets. Fortunately, it was possible to release some income-producing office space, and the return from investments was fully up to expectation.

Properties for which the corporation is responsible (real estate at cost, funds at book value, and library as appraised) total nearly \$4,000,000. On December 31, 1934, the aggregate book value of investments was \$1,338,852.98, and the market value was \$1,236,677.25. It is noteworthy that during 1934 the market has advanced on practically all securities held by the corporation.

One very important action of the trustees was the revision of by-laws for the purpose of meeting changing conditions, which necessitated changes in practices, procedure, and personnel.

A Building Improvement Committee examined conditions in the Engineering Societies Building, and authorization was granted by the trustees for redecorating the fifth floor assembly halls and main floor lobby, re-upholstering the auditorium seats and lobby furniture, purchasing new chairs for the assembly halls, providing new and adequate illumination in office space and assembly halls, repairing leaky windows, and conserving heat and comfort.

The Board of Trustees has recognized that its function is to act for the Founder Societies in certain important activities which have been entrusted to it, and to incur no new obligations unless so requested by the Founder Societies. During the past year the board has endeavored to clarify procedures, by-laws, and methods, in order to transact the business before it in an expeditious and efficient manner. The annual audit shows that the affairs entrusted to the corporation by the Founder Societies are in good condition and that several highly important things have been accomplished during the year, which would tend to further unify the great professional societies.

The Engineering Societies Library

By Walter I. Slichter, Chairman, Board of Directors, Engineering Societies Library

Professor of Electrical Engineering, Columbia University, New York, N.Y.

The Engineering Societies Library was established in 1907, when three of the Founder Societies combined their separate libraries into one collection in common quarters. In 1913 these were formally organized into the Engineering Societies Library, and in 1916 the American Society of Civil Engineers joined by adding their very considerable collection to the joint venture.

This library, which is the largest maintained by any professional organization, has a world-wide reputation. Its collection has grown steadily from 62,000 volumes in 1914 to 145,000 in 1935, an increase of 114 per cent, and the number of persons making use of these facilities has increased even more substantially—from 14,000 in 1914 to 41,000 in 1934, an almost threefold increase. During the past year engineers in 45 states and 21 foreign countries were helped by loans of books and copies or translations of articles. One-fourth of those who consulted the library in 1934 did so by correspondence without ever setting foot inside the building. Thus the benefits of the library are not confined to those in New York City.

In 1934 the cost of operation was \$48,500, of which the Founder Societies contributed \$30,000, or 60 cents per member. The sum of \$8,500 was earned by special services, and the remainder came from the small endowment. During this period 4,100 volumes were added to the collection; these have been conservatively appraised at \$15,000. The yearly increase in the money value of the library is an important item, as a considerable capital investment that is now appraised at \$500,000 is gradually being built up.

Since so many engineers are employees of large corporations, such corporations should provide library facilities as they provide other business requirements. This they can do in the most effective way by building up the Engineering Societies Library to even greater effectiveness.

Of late there has been need for closer cooperation between the library and members of the societies living at a distance from the city. Some years ago, to meet this need we started a circulating library to which any member of the four Founder Societies may apply for any book that is purchasable. If the book is not in the auxiliary collection, it is purchased and sent to the member, who is charged a reasonable rental. In this way a lending library is being built up with no expense to the budget because the service is self-sustaining. To increase the usefulness of the library a plan is now being put into effect, which will assist the public libraries in the various towns and cities to provide better facilities for the engineers of the neighborhood. It is hoped also that it will be possible to build up a more ambitious auxiliary lending library.

The Engineering Foundation

By H. P. Charlesworth, Chairman of the Board, The Engineering Foundation

Assistant Chief Engineer, American Telephone and Telegraph Company, New York, N.Y.

In 1914, through the generosity of Ambrose Swasey, of Cleveland, Ohio, there came into being The Engineering Foundation. In that year Dr. Swasey made the first of four gifts to the Founder Societies as a nucleus to which other persons might add in order to build up a great endowment. The advantages of utilizing the facilities of an organization already established for carrying on the joint undertakings of the societies were recognized, and the fund was entrusted to United Engineering Trustees, Inc. The Engineering Foundation was then organized as a department of that organization, but given full discretionary powers.

So far as I know, The Engineering Foundation is unique in the engineering field. It is composed of representatives of the Founder Societies instead of being a closed, self-perpetuating group. Its charter wisely allows wide latitude of operation to conform to changing conditions as time goes on. By the nature of its organization it will at all times have at its command the voluntary and worthy efforts of outstanding engineers to administer this great trust in behalf of the profession and mankind generally.

The Board of The Foundation has discretionary powers in its use of the income from funds held by United Engineering Trustees, Inc., or from other sources. Its principal duty is the selection or initiation of projects most likely to advance the profession in its service to the public. Other things being equal, proposals recommended by the Founder Societies are given preference.

In 1915 the resources of The Foundation yielded an income of \$5,000, and in 1934 of \$40,000. An additional \$230,000 in contributions has passed through its hands. A great deal of money and materials has been contributed by cooperating organizations as well as the services of outstanding engineers and scientists. The Foundation has no laboratories or research staff. Needed facilities and personnel for carrying on research have been furnished by colleges or other existing establishments. Such cooperating agencies include governmental bureaus, trade associations, industries, banks, and technical and scientific societies.

Mention of some of the activities that The Foundation has carried on in the past 20 years attest the scope, variety, and range of magnitude of its undertakings. In the educational and sociological field, it has assisted in the establishment of the National Re-

search Council, the Highway Research Board, the Personnel Research Federation, and the Engineers' Council for Professional Development. It has published research narratives and other pamphlets and books and has bettered engineering education through investigations of institutions, methods, and needs. It has established summer schools for engineering teachers and is responsible for the production and distribution of the booklet, *Engineering: a Career—a Culture*. Among its many publications is a series of ten *Courses for Disengaged Engineers*, a brochure on technical, financial, and personnel subjects, given to 600 engineers in the Engineering Societies Building.

THE AMERICAN STANDARDS ASSOCIATION

By HOWARD E. COONLEY, PRESIDENT, AMERICAN STANDARDS ASSOCIATION, PRESIDENT, WALWORTH COMPANY, NEW YORK, N.Y.

MORE THAN twenty years ago small groups of engineers were discussing informally the formation of an organization that was destined to become the American Standards Association. I doubt that even the most far-sighted of them could have foreseen that their plans would develop into an organization of more than 3,000 technologists and other experts working on more than 200 standardization and safety-code projects now under way or in the process of revision.

The American Standards Association was organized in 1918 as the American Engineering Standards Committee by five major engineering societies—the American Society of Mechanical Engineers, The American Institute of Electrical Engineers, the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, and the American Society for Testing Materials. Two years later several government departments and bureaus became member bodies.

In this country the standardization movement was given its first great impetus during the World War, when the mass production of ordnance and war supplies of all kinds gave the new stimulus to manufacturing that has made the United States the greatest manufacturing nation on earth. Interchangeability, a corollary of mass production, demands standardization of measurements and tolerances. Thus a natural and logical movement toward standardization was organized by industry to serve its ends. Starting as this movement did in machine shops with screw-thread standards, fits, and industrial safety codes, it has outgrown the narrower confines of the shops and has become an important factor in every major manufacturing industry and in the homes of consumers, and today American standards and safety codes are used in every state.

However, the association is still a central clearing house for such standards and safety codes. Because no standard or safety code is worth anything unless a substantial majority of interested groups is willing to use it, the function of determining a consensus is one of the primary purposes of the organization. This also means that every interested group must be invited to send its representatives to cooperate in working out the standard.

In 1929 the old American Engineering Standards Committee was changed into the American Standards Association, and today the association is going through another reorganization to make it fit more perfectly into our changing industrial and economic life. In spite of these two reorganizations, however, no reason has been found for changing the fundamental functions of the association. Today, as always, a democratic forum must be maintained for varying points of view. Obviously, because of wider industrial activities, democratic representation is more difficult to achieve and arriving at an agreement offers more problems than ever before. The changes in the set-up of the association are simply calculated to expedite work without jeopardizing the right of industries, consumers, and government agencies to present their respective cases in court.

Nearly half of the 514 approved NRA codes carry provisions of the American Standards Association. Several hundred of these include safety codes, many of which were developed through the association and approved by technical societies, manufacturers, consumers, and interested government agencies. A large number of states have written the safety codes of the association into their regulatory provisions, and its work on building codes, now under way, will carry the findings of the association into every town and city in the country.

(*Abstracts of the five other addresses made at the May 20th meeting will appear in the August issue.*)

Visits to Local Sections and Student Chapters

EN ROUTE to the Convention at Los Angeles on July 3 and 4, Secretary Seabury visited the Kansas City Section on June 24 and the New Mexico Section at Santa Fe on June 26.

Field Secretary Jessup visited the Nebraska Section at Omaha on June 19 and the Utah Section at Salt Lake City on June 24. Prior to his return to the East, he plans to visit the San Diego, Arizona, Los Angeles, San Francisco, Sacramento, Portland, Tacoma, Seattle, Spokane, Duluth, and Twin Cities Sections.

Later in the fall he will visit the Iowa and Oklahoma Sections, the Mid-South and the Tennessee Valley Sections, the Alabama Section, and those not previously visited in Upper New York State. During the college season he will visit also as many of the Student Chapters as practicable.

Thus during this calendar year it is hoped that every one of the Society's 57 Local Sections and many of its 111 Student Chapters will have had first-hand opportunity to know intimately of the Society's activities, of its condition, and of the things that it has accomplished and hopes to accomplish in behalf of its members.

Library Furnishes Bibliographies

MANY ENGINEERS may be unfamiliar with the work of the Service Bureau maintained by the Engineering Societies Library in New York, N.Y., for the benefit of the engineer who cannot visit the library in person. One of the services offered by the bureau is the furnishing of bibliographies on a wide variety of subjects. There are in its files more than 4,000 bibliographies on engineering themes, and copies of any of them may be secured for a moderate copying charge. Of course the period covered by them and their degree of completeness varies with the purpose for which they were prepared, the time when they were prepared, and other factors. Some are as of a very recent date; others trace a branch of engineering back to its beginning. However, they may all be extended backwards or brought up to date as required.

If a specific problem is not solved by a bibliography already in its files, the Service Bureau will gladly try to find the information needed, and if that cannot be done within the time available for free work it will inform the inquirer of the need for a search and its probable cost.

Wherever an engineer may be, the Service Bureau will act for him by searching out specific information on any phase of engineering, by preparing bibliographies, abstracts, photoprints, and translations, and by supplying bibliographies and translations from its extensive files. All services are rendered at cost. For further information, inquiries by mail, wire, or phone should be addressed to the Engineering Societies Library, at 29 West 39th Street, New York, N.Y.

Engineers Plan to Gain Recognition as a Profession

Society Joins with Six Other Representative Societies in E.C.P.D.'s Program to Establish Criteria of Education and Practice, and to Certify Professional Qualifications of Engineers

WHO is an engineer, and by what right does he use that title or undertake to practice engineering? At present there is no clear answer to this question. There is no single criterion by which an engineer's qualifications can be measured, either by his fellows or by the public that uses his services. His legal status is determined

in some states by a process of examination, registration, and licensing. His educational status may be indicated by a college degree, and his technical qualifications by his grade of membership in a national society of high repute. Not all engineers are licensed. Neither do they all possess college degrees or hold membership in a technical society. From the point of view of professional solidarity the situation is chaotic.

As part of its plan to enhance the professional status of the engineer, the Engineers' Council for Professional Development (E.C.P.D.) has undertaken to define minimum qualifications of education and experience, the fulfillment of which will entitle an engineer to be recognized as such among his fellows and in his relations with the public. In addition to the four Founder Societies, the participating bodies are the American Institute of Chemical Engineers, the Society for the Promotion of Engineering Education, and the National Council of State Boards of Engineering Examiners, all of which are represented on E.C.P.D.'s Committee on Professional Recognition. Through this committee, the E.C.P.D. has proposed a minimum definition of an engineer, and a program of certification into the profession. The definition of an engineer sets up minimum qualifications of technical education and practical experience, supported by examinations designed to indicate the individual's ability to be placed in responsible charge of engineering work and to render him a valuable member of society. These proposals are now before the governing boards of the constituent bodies of the E.C.P.D. When approved they will provide the criterion and the mechanism for the professional recognition of engineers.

The certification program recognizes the fact that the equivalent of a "grandfather clause" must be applied to permit automatic certification of those who are now recognized and accepted as engineers by legal authorities and by the profession. It also contemplates a reasonable transition period for the progressive adjustment of requirements and the tightening of standards until the full program for certification can be put into effect. Thus licensed engineers and certain members of technical societies will be automatically eligible to receive certificates according to a chronological plan up to January 1, 1938, at which time a prescribed procedure leading to certification will be put into effect. When that goal is reached, it is hoped and expected that certification of an engineer by the E.C.P.D. will set a minimum standard of professional training and experience by which he will be accepted and recognized among his fellows and in his relations with the public.

American Engineering Council

The Washington Embassy for Engineers, the National Representative of More Than 200 National, State, and Local Engineering Societies Located in 40 States

Work Relief Notes

Administrators of government funds of the several agencies of government are now scrutinizing with renewed care the exact phraseology of the legislation which gives them their authority, and this is also true of those who administer the work relief program and those who are expected to benefit by it. The re-defining of authority now taking place is further affected by the interrelation of state and federal relief laws. This situation tends to make it more difficult to straighten out the organization and expenditure of the work relief program. Because of the confusion that exists both outside and in Washington, it seems worth while to re-state the fundamental philosophy and purpose of the work relief bill:

1. The bill was designed to provide funds to employ for one year 3,500,000 heads of families now on relief. It was conceived primarily as a relief measure and not as an employment measure. The sum of four billion dollars makes the pay of a man on relief $19 to $94 a month, with an average of $50—set purposely low so that those on relief would prefer private employment.
2. The bill provides that this work shall be carried out within the locality of a man's present place of residence. In other words, local projects of such character as to lend themselves to relief work would employ men and women on local relief rolls.
3. The type of any given project is to be determined by the training and experience of available relief labor in the locality.
4. This whole program reflects the intention that work relief shall not be made too attractive.
5. The bill makes provision for paying administration expenses, not on the basis of relief compensation, but of prevailing local rates or fees.

Engineers Should Participate in Public Affairs

The need for increased participation of engineers in public affairs is becoming more and more recognized throughout the profession. If engineers really are to have influence in public affairs, the field must be developed along lines of engineering analysis in the same way that the technique of the profession has taken form over the past several decades. There is now an extensive literature of engineering technique so that a specialist in any branch of the profession may read the record of successful experience in relation to his problems. But the equally broad field of public affairs has not been fully explored and charted by engineers.

Recent Activities of the A.E.C.

The Council is working on a plan which ultimately will result in the setting up of state and regional public affairs committees composed of key men in each area. The Council's system of membership committees, now rapidly developing to encourage state and local societies to join the Council under the new plan of nominal dues, is a step toward the final set-up. In the meantime, the Council is seeking to assemble material in an effort to build up a record of contributions of engineering societies to public affairs, and facts on this subject will be appreciated.

The meeting of the Council's executive committee in New York May 20, 1935, covered many subjects of basic interest to the profession. Reports of several committees were accepted, and steps were taken to effectuate plans for membership, public affairs activities, and special investigations, which were brought forward at the annual meeting in January.

The report of the Water Resources Committee was approved. The report advocates the establishment of an interdepartmental board of water resources investigation to correlate the investigational functions of federal agencies dealing with water resources. In connection with plans for federal reorganization, a bureau of water resources was endorsed in principle. Favorable comment was made on the collection and systematic arrangement of a large mass of information covered by the report of the Water Planning Committee. Extension of this work was recommended through a National Advisory Water Planning Agency. As to legislation, it was pointed out that many bills that are introduced in Congress have a tendency to stress the importance of water power at the expense of the other urgent needs for water; also to overlook the known facts that limit the economic development of available power sites. Opposition to the establishment of additional river basin authorities along the lines of the TVA at the present time was adopted as a policy of the Council.

Boards of Civil Service Appeals, to settle differences between federal civil service employees and their superiors, are proposed in the Sirovich Bill (H.R. 3980). As the measure was first drafted, the representative of the employee on the three-man board set up to hear the cases would have been a representative of the international union to which the employee belonged. But a revision permits the employee to choose his own agent, so that technical societies may act in the case of an engineer. The other two members of the board would represent the Civil Service Commission and the federal department or agency involved. Cases of engineers who have qualified under the Civil Service and feel that the rating has not given them the guarantee of employment to which they are entitled, are being studied. A preliminary study of the general subject of the relation of engineers to the U. S. Civil Service has been started by Arthur W. Berresford, former president of the Council.

The Anti-Gasoline-Tax-Diversion Association has asked the Council to support the idea of restricting gasoline taxes to highway

purposes. The Executive Committee suggested that this will be a desirable project to refer to the state public affairs committees when they are formed.

The Council's support of a program of aviation research under the National Advisory Committee for Aeronautics was recommended by the Council's Committee on Aeronautics and approved by the Executive Committee. The desired program is set forth in a paper by Dr. Alexander Klemin, secretary of the committee. Copies are available on request. Briefly, the recommendation is that the National Advisory Committee for Aeronautics receive $50,000 per year of federal funds earmarked for research to be done by universities and other institutions of public standing, but not for educational purposes, buildings, or basic equipment. Scientific workers of approved institutions desiring to do research would submit formal plans. Results would be published by the Committee for Aeronautics in the form of technical notes or reports. A committee representing the N.A.C.A., Navy, Army, and Department of Commerce would supervise.

Washington, D.C.
June 10, 1935.

Columbia University Scholarship

THOSE STUDENTS or young graduates who are contemplating pursuing more extended, or graduate studies in civil engineering should give thought to the possibility of the Columbia University Scholarship. This prize has been known as the Horatio Allen Scholarship in memory of a noted graduate of Columbia who later became an eminent engineer and President of the Society. It is made available to the candidate designated by the Society and approved by the University. The next appointment will be for the year 1935–1936 and for such appointment application should be filed without delay.

In particular this award should appeal to the outstanding student who has already completed two years or more of undergraduate work and desires to avail himself of the facilities of a large institution and metropolitan surroundings. Under ideal circumstances, such a scholarship might be made available for three years of continuous study, depending on the aptitude, success, and inclination of the holder of this scholarship. The money value is estimated as at least $400 per annum.

Inasmuch as the decision on this scholarship is to be made shortly, applicants should not delay to fulfill the formalities. All necessary details will be gladly supplied on request to Headquarters. This is the last notice of this award for the current year.

Society Status of Mississippi State College

AT THE meeting of the Board of Direction held in Miami, Fla., April 4, 1935, it was announced that the Committee on Accredited Schools had unanimously recommended that certain privileges be restored to the Mississippi State College. This special status, including the assigning to graduates of professional credit for academic work when applying for membership in the Society, is enjoyed by all the institutions which have Student Chapters of the Society. In the present instance, it was granted as the result of an examination of the curriculum and a visit to the college by M. L. Enger, former Director of the Society and chairman of the Committee on Accredited Schools. The recommendation of the committee was thereupon approved by the Board.

Previously this institution, then known as the Mississippi Agricultural and Mechanical College, had been granted this privilege, beginning in 1928. Then, in 1930, because of the disrupting effects of sweeping political interference with the faculty and administration, the Board decided that the college could no longer be regarded with favor by the Society. These adverse conditions are now found to have been overcome, so that it has appeared to the Board of Direction appropriate to restore to the college its prior status.

Society Appointees

J. K. FINCH and R. S. KIRBY, Members Am. Soc. C.E., will represent the Society on a Joint Committee on Engineering History, to be composed of representatives of the engineering societies for the purpose of developing a plan for the stimulation of historical research and the recording of current engineering progress.

SAMUEL A. GREELEY, M. Am. Soc. C.E., has accepted a reappointment to serve as a Society representative on the Washington Award for the two-year term, August 1935 to August 1937.

JOHN H. GREGORY, M. Am. Soc. C.E., will represent the Society on the Division of Engineering and Industrial Research of the National Research Council.

JOHN C. HOYT, M. Am. Soc. C.E., has been appointed to fill the vacancy caused by the death of C. E. Grunsky, Past-President Am. Soc. C.E., on the project of the American Standards Association on "Rating of Rivers."

RUDOLPH P. MILLER, M. Am. Soc. C.E., has accepted an appointment to serve as a Society representative on the Building Code Correlating Committee of the American Standards Association.

ALBERT F. REICHMANN, M. Am. Soc. C.E., has been appointed to fill the vacancy on the Society's Research Committee caused by the death of H. de B. Parsons, M. Am. Soc. C.E.

MELVIN S. RICH, M. Am. Soc. C.E., has been appointed an alternate on the Building Code Correlating Committee of the American Standards Association.

JESSE W. SHUMAN, M. Am. Soc. C.E., will represent the Society at the summer meeting of the American Association for the Advancement of Science, to be held in Minneapolis, Minn., June 24 to 29, 1935.

JAMES G. STEESE, M. Am. Soc. C.E., will serve as Society delegate to the Sixteenth International Navigation Congress, which is scheduled to be held in Brussels, Belgium, September 2–10, 1935.

News of Local Sections

DAYTON SECTION

There were 18 present at a luncheon meeting of the Dayton Section held on May 20 at the Engineers' Club. Several business matters were discussed, and an excellent, illustrated talk was given by J. A. K. van Hasselt, professor of civil engineering at Antioch College and formerly an engineer in the Dutch East Indies. His subject was "Experience in Water Power Explorations in the Dutch East Indies."

KANSAS CITY SECTION

A meeting of the Kansas City Section was called to order on May 21, with 35 members and 9 guests present. After numerous business matters had been discussed, the speaker of the evening, Paul Thornton, was introduced. Mr. Thornton, who is with the Aluminum Company of America, gave an interesting illustrated talk on structural aluminum.

LOS ANGELES SECTION

The Los Angeles Section met at the California Institute of Technology on May 8, members of the Section being guests of the California Institute of Technology Student Chapter. During the dinner, which was served under the olive trees in Dabney Gardens, a program of vocal and instrumental music was furnished by the students. After dinner the members and guests adjourned to Culbertson Hall, where the rest of the program was conducted.

The first speaker was Dr. Robert Andrews Millikan, chairman of the Executive Council of the institute, who discussed the significance of recent sub-atomic discoveries. He was followed by Dr. John H. Maxson, of the geology department of the institute. The attendance was 240.

Louisiana Section

At the annual meeting of the Louisiana Section, held on May 29, the following officers were elected: F. P. Hamilton, president; Clifford H. Stem, first vice-president; H. A. Sawyer, second vice-president; A. M. Fromherz, treasurer; and Charles M. Kerr, secretary.

Mid-South Section

On May 24 and 25 the annual meeting of the Mid-South Section was held in Little Rock, Ark. The first day was devoted to the presentation of interesting papers on a variety of timely engineering topics. Among those who spoke were Gen. Harley B. Ferguson, president of the Mississippi River Commission; Walter C. Carey, Second New Orleans District, Corps of Engineers; F. G. Jonah, chief engineer of the St. Louis and San Francisco Railway Company; and H. C. Beckman, District Engineer, U. S. Geological Survey. In the evening a banquet, entertainment, and dance were enjoyed in the ballroom of the Hotel Marion, the headquarters of the meeting. During the business session on Saturday morning officers for the coming year were elected as follows: George R. Clemens, president; John H. Gardiner, vice-president; and Dewey M. McCain, secretary-treasurer. Later in the day a motor trip to Hot Springs was enjoyed, and an inspection trip was made to Remmel and Carpenter dams. Representatives of the Arkansas Power and Light Company were in charge of this feature of the entertainment.

Northwestern Section

A joint meeting of the Northwestern Section and the University of Minnesota Student Chapter was held at the Campus Club in Minneapolis on May 22. The feature of the occasion was an address by William F. Holman, supervising engineer of the buildings and grounds of the university.

Philadelphia Section

In connection with the meeting of the Philadelphia Section held on May 15, an inspection was made of the subway section at the Philadelphia end of the high-speed line being constructed between Philadelphia and Camden, N.J. Another improvement viewed at this time was the Upper Moreland–Hatboro sewage-disposal plant near Willow Grove, Pa. At the evening meeting prizes were awarded in the Section's annual Student Chapter prize competition. Then instructive talks were given by Charles F. Mebus and H. J. Knopel, consulting engineers. A party of 58 members and guests made the inspection trip; 32 attended the dinner; and 52, the evening meeting.

Pittsburgh Section

At a meeting of the Pittsburgh Section held on May 4, officers for the coming year were elected as follows: C. G. Dunnells, president; R. P. Forsberg, vice-president; and Nathan Schein, secretary-treasurer.

Portland (Ore.) Section

There were 31 present at a meeting of the Portland (Ore.) Section held on April 30. The speaker of the evening was O. R. Bean, city commissioner and member of the Oregon State Planning Board, who spoke on state planning. A general discussion of planning followed his talk. The Portland Section convened at Oregon State College in Corvallis on May 25, the first annual Engineers' Day. Local branches of the other founder engineering societies participated in the program, which included a golf tournament, baseball game, and inspection of the engineering laboratories at the college. The prize-winning paper in the annual Student Chapter competition was read at the technical session, and a dinner and dance were enjoyed in the evening.

San Diego Section

At the April meeting of the San Diego Section S. B. Morris, superintendent and general manager of the Pasadena Water Department, was guest of honor. Mr. Morris gave a very interesting description of the construction methods used at Pine Canyon Dam, lately renamed Morris Dam in his honor. At the May meeting of the Section the annual "Ladies' Night" was celebrated. After dinner a short program preceded a very interesting talk on diamonds given by Armond Jessop.

Spokane Section

The Spokane Section held its regular monthly meeting at the Davenport Hotel on May 10 to discuss the Professional Engineers' Registration Act, passed at the last session of the state legislature. This discussion proved interesting and animated, and several recommendations were made for further study.

St. Louis Section

There were 56 members and guests present at a meeting of the St. Louis Section held on May 27. The feature of the occasion was a talk by E. L. Daley, Division Engineer, Corps of Engineers, Upper Mississippi Valley Division. Colonel Daley gave an interesting discussion of the topic, "Canalization of the Upper Mississippi."

Syracuse Section

At a meeting of the Syracuse Section held on May 21, the following officers were elected for the ensuing year: Nelson F. Pitts, president; Francis D. McKeon, first vice-president; William F. Kavanaugh, second vice-president; and G. Perry Dunn, secretary-treasurer. A few short talks enlivened the evening as did the presentation of a stroboscopic motion picture taken at Massachusetts Institute of Technology.

Student Chapter News

California Institute of Technology

On May 8 the California Institute of Technology Student Chapter was host to the Los Angeles Section of the Society at a dinner meeting held on the campus of the institute. The dinner was preceded by an inspection of the interesting engineering projects being developed on the campus, including a high-voltage exhibit in the million-volt laboratory, and a demonstration of the grinding of the 120-in. mirror that is being prepared for the new astronomical observatory. After dinner Dr. Robert A. Millikan and Dr. John H. Maxson, of the California Institute of Technology, gave interesting half-hour talks.

Kansas State College

The Kansas State College Student Chapter has held several interesting meetings in the past few weeks. On March 13, the members had the pleasure of hearing Henry E. Riggs, Vice-President of the Society and former professor of civil engineering at the University of Michigan, who discussed the aims and activities of the Society. At a meeting held on April 4 the speaker was N. T.

Kansas State College Student Chapter

Veatch, of the firm of Black and Veatch, of Kansas City, Mo., who spoke on the subject "Economics of Sewage Disposal Design for the City of Denver, Colo." A smoker, held on the evening of May 2, was the occasion for the presentation of a symposium on the topic, "The Young Man and Civil Engineering." A social hour and refreshments were enjoyed at the conclusion of the meeting.

ITEMS OF INTEREST

Engineering Events in Brief

Civil Engineering for August

A comprehensive résumé of river and harbor work in the United States from its inception up to the present is presented in two articles by Lytle Brown, M. Am. Soc. C.E., Brigadier General, U.S.A., and former Chief, U. S. Engineer Corps. The first of these papers, tracing the development of a river and harbor policy by the federal government, will appear in the August number. It is concerned with the earliest controversies over the use of federal funds for public works, and the constitutional authority therefor; the machinery for originating and putting into effect the necessary preliminary legislation and preparing and executing plans; the reasons for distributing the responsibility for execution of public projects among the departments of War, Navy, Commerce, Interior, and Agriculture; and the value in national defense of good transportation facilities both on land and water. General Brown's second article, dealing with recent major river and harbor developments throughout the country, will appear in a later issue.

To promote recreational use of the recently acquired Shenandoah National Park in Virginia, the federal government is constructing a 34-mile parkway along the main divide of the Blue Ridge. A description of this and spur roads forms the subject of an article by H. J. Spelman, M. Am. Soc. C.E. A great deal of care in making the alignment was required to avoid exceeding the planned 150-ft minimum radius of curvature and the 7 per cent maximum grade. Spiral easements were fitted to all curves, and superelevation was provided on curves of one degree radius and more. The principal aim, to construct an attractive highway giving access to the more scenic parts of the mountains, has been fully attained.

Pier design and construction is a branch of civil engineering work which appears rather infrequently in technical articles. In his description of the Indian River refrigeration terminal at Fort Pierce, Fla., George Perrine, M. Am. Soc. C.E., discusses the considerations involved in constructing a plant with pre-cooling, storage, and shipping facilities adequate to handle up to 167 carloads of citrus fruits weekly. This plant is located in the heart of a famous citrus belt. It is situated on a pier in the Indian River which is navigable by practically all seagoing vessels, is served by the Florida East Coast Railroad, and is connected with the Dixie Highway by a short section of hard-surfaced road.

Following the example set by the United States, the British Government, in December 1922, remitted to China the balance of the indemnity exacted for damage and loss of life occasioned during the Boxer Rebellion of 1900. This fund of £1,660,000 for British materials and $32,000,000 for labor and native materials was utilized by the Chinese Government for the completion of the 680-mile Canton Hankow Railway, in the construction of which H. H. Ling, M. Am. Soc. C.E., served as director and engineer-in-chief of the Chuchow Shaochow section. This enterprise is of interest principally on account of the remoteness of the location, which passes through some extremely wild and rugged country accessible only by the use of rocky paths and shallow, rapid mountain streams. Limestone in large quantities at or near the surface of the ground necessitated a great deal of drilling and blasting. This was accomplished by mounting portable air compressors on small boats in adjacent streams. Even so, however, the transportation of this equipment proved exceedingly difficult, due to the steep slopes of the river banks. It is hoped that Mr. Ling's residence in a distant country will not prevent making the final arrangements for publishing his paper in time for the August issue.

Mural Painting "Power"

On the page of special interest in this number appears a reproduction of one of four mural paintings by Ettore Caser hanging in the Engineers' Club of New York. These murals, depicting some of the activities of the engineering profession, decorate the club's dining room. Reproductions of two other paintings in this series have appeared on the page of special interest in previous issues of Civil Engineering: one on "The Skyscraper" in the October 1934 issue, and one on "The Canyon" in the October 1933 issue.

Honorary Degrees Awarded

At commencement time each year the achievements of prominent engineers are recognized by the award of honorary degrees to those who have made outstanding contributions. Several members of the Society are among the engineers thus honored during the 1935 commencement season. In addition to the following, there are doubtless others who have received awards, of whom information has not yet been received at Society Headquarters.

John F. Coleman, Past-President Am. Soc. C.E., Doctor of Engineering, Tulane University.

Francis I. Crowe, M. Am. Soc. C.E., Doctor of Engineering, University of Maine.

Charles R. Gow, M. Am. Soc. C.E., Doctor of Engineering, Worcester Polytechnic Institute.

Charles T. Main, M. Am. Soc. C.E., Doctor of Engineering, Northeastern University.

Edward M. Markham, M. Am. Soc. C.E., Doctor of Engineering, Rensselaer Polytechnic Institute.

Edward E. Wall, M. Am. Soc. C.E., Doctor of Laws, University of Missouri.

Aubrey Weymouth, M. Am. Soc. C.E., Doctor of Engineering, Lehigh University.

Walker R. Young, M. Am. Soc. C.E., Doctor of Engineering, University of Idaho.

In connection with these awards it may be of interest to note that Mr. Coleman is head of the J. F. Coleman Engineering Company, a consulting engineering firm in New Orleans, La.; that Mr. Crowe, who is in the employ of Six Companies, Inc., is in charge of construction for the contractor at Boulder Dam; that Mr. Gow is president of the Warren Brothers Company, of Cambridge, Mass.; and that Mr. Main is president of Charles T. Main, Inc., of Boston, Mass. General Markham is Chief of Engineers of the U. S. Army, with headquarters in Washington, D.C.; Mr. Wall is a consulting engineer and director of public utilities of St. Louis, Mo.; Mr. Weymouth, as vice-president and chief engineer of Post and McCord, Inc., of New York, N.Y., has supervised the erection of many New York skyscrapers; and Mr. Young, in the capacity of construction engineer for the U. S. Bureau of Reclamation, has been in charge of the construction of Boulder Dam.

Novel Method of Dewatering a Cut

An unusual method for pumping out a large cut near Melbourne, Australia, is described in a letter to Society Headquarters from Bernhard A. Smith, M. Am. Soc. C.E., consulting engineer of Melbourne. The site of the work is at Yallourn, 90 miles east of Melbourne, where stripping operations for the mining of brown coal have resulted in a large open cut situated immediately adjacent to the Latrobe River. On December 3 and 4, 1934, this river rose to unprecedented heights and poured approximately 5,410,000,000 U. S. gallons into the cut. Pumps mounted on rafts were operated in parallel while the head to be pumped against was small, and as the water level was lowered the pumps were connected in series. The water was discharged at the rate of about 3,000,000 gal per hr.

The Yallourn power house and cut were inspected during the Melbourne Centenary Engineers Convention, held on March 4, 1935, at which Mr Smith conveyed greetings of welcome on behalf of the Society. About 800 members of the Institution of Engineers of Australia attended, as well as 400 guests.

Altitude Observations on Stratosphere Balloon

A BRIEF announcement of the stratosphere balloon flight sponsored by the National Geographic Society and the U. S. Army, appeared in the June issue of CIVIL ENGINEERING. Further information about the contemplated flight near Rapid City, S.D., was later received at Society headquarters from J. H. Hawley, M. Am. Soc. C.E., acting director of the U. S. Coast and Geodetic Survey.

In previous flights the altitude of the balloon has been obtained by barograph readings of atmospheric pressures. There is evidence, however, that the pressure tables used in such determinations give altitudes lower than those actually attained by the balloon. The altitude may also be obtained by taking photographs from the balloon of the terrain vertically below. By scaling on the photographs the lengths between points on the ground, the distances of which are known, the height of the balloon may be determined. This presupposes the existence of accurate maps or surveys over the region covered by the flight, a condition which does not always exist.

In order to determine the height accurately, the U. S. Coast and Geodetic Survey has a number of triangulation survey stations located throughout the region over which it is expected the flight will occur, marked by bronze disks set in concrete monuments. The latitude and longitude of these marked points are known. An azimuth, or direction to a nearby point, has also been determined for each station.

Engineers or surveyors equipped with ordinary transits will be stationed at triangulation points at 30-mile intervals throughout the region. These men will measure the horizontal angle from the azimuth mark to the balloon, and also the vertical angle from the horizontal plane to the balloon.

If such data are obtained simultaneously from two stations, the distance between which is known, then the height of the balloon above the known stations can be determined. If the data are also obtained at the same instant from a third triangulation station, a check on the altitude can be made.

As it is necessary that such observations be made simultaneously, it is proposed to utilize as a signal for marking, the code word announcements broadcast by commercial radio stations. It is hoped that the signals from the same broadcasting station can be picked up on the ordinary car radio by observers at the various survey stations in any given locality.

The flight will be made under ideal weather conditions. It is reasonably certain that the balloon will fly from Rapid City in a generally southeasterly direction somewhere within the 60-deg sector with the northeastern limit passing south of Des Moines, Iowa, and the western limit following closely the western boundary of Kansas. Last year, under atmospheric conditions which it is hoped will be duplicated this year, the balloon came down at Holdredge, Nebr. It is possible that the length of the flight this year may be twice that of 1934. Preparations are at present sufficiently advanced to indicate that the balloon will take to the air as soon as weather conditions permit. The data obtained will be of value in studies of atmospheric pressures at various heights.

Atmospheric studies will be made daily before the flight at the camp site near Rapid City, S.D., and when conditions are such that clear weather will be a certainty, the observers will be notified that the flight will occur the following day. The balloon will be released early in the morning between 4:00 a.m. and 5:00 a.m. At a height of 28,000 ft the balloon will be leveled for a series of observations. These will be completed by 9:00 a.m., and the attempt will then be made to reach the highest altitude possible. It is entirely possible that an altitude of 75,000 ft may be attained. It is between the hours of 9:00 a.m. and 3:00 p.m. that visual observations from ground stations at 15-min intervals are desired.

Forty engineers in Nebraska and fifty in Kansas have volunteered their services as observers. Willard J. Turnbull, of the University of Nebraska; L. E. Conrad, M. Am. Soc. C.E., of Kansas State Agricultural College; and J. S. Dodds, M. Am. Soc. C.E., of Iowa State College, have been of service in enlisting volunteers for the work.

Largest All-Welded Bridge Completed

IT IS claimed that the bridge recently completed across the Rancocas River, connecting Riverside and Delanco, N.J., is the largest truss bridge ever built by welding in this country. This structure, with a roadway of 36 ft and one sidewalk 5 ft wide, consists of two fixed spans each 112 ft 8 in. long and a center swing span 160 ft long. The total length of the bridge, including parts over piers and abutments, is 397 ft.

The fixed trusses were each shop-welded in three parts and field-welded into one. A saving in total weight of 10 to 15 per cent was realized through the use of welding, principally in web and chord members. The cost of the bridge was $270,800.

A total of 24,000 lin ft of electric welding by the shielded arc process was required to fabricate and erect the steelwork. Of this amount, approximately two-thirds was done in the shop. The Lincoln Electric Company of Cleveland, Ohio, supplied equipment and electrodes for the welding work.

© Lincoln Electric Company

TRUSS FRAMING, RIVERSIDE–DELANCO BRIDGE, RIVERSIDE, N.J., SHOWING WELDING CONNECTION DETAILS

© Lincoln Electric Company

GENERAL VIEW OF RIVERSIDE–DELANCO BRIDGE, RIVERSIDE, N.J.

Good Manners a Recognized Course at an Engineering College

A PAMPHLET entitled *The Teaching of Good Manners*, by Mary P. Barker, has recently been published. It contains the subject matter of a course of lectures at the Newark College of Engineering. Dean Kimball of Cornell University says of this publication, "It will repay reading, particularly if the reader will recognize his own difficulties and make an effort to correct them."

It is pointed out in the opening paragraphs that opportunities come largely through friends. Personal appearance and table manners are next discussed. The proper method of making introductions is a very useful item of general interest. The pamphlet closes with some good advice about the lack of consideration for others shown by some of those who smoke in confined spaces.

Too often engineers are criticized as having been cast in a rough-and-ready mold and as lacking polish, but little criticism has been heard on the score of basic worth. It is undeniable that all engineers, particularly those starting out in their chosen field, can find much of value in Mrs. Barker's brief but pointed advice. The booklet is being distributed by John Wiley and Sons, 440 Fourth Avenue, New York, N.Y., at a cost of 15 cents per copy.

Engineering Classes in Colleges Smaller

ENROLMENT in engineering and architectural courses in the universities and colleges of the country during the last five years has fallen about 25 to 35 per cent according to a news article in *The New York Times* for June 14, 1935. Registration actually increased in many colleges after the economic crisis of 1929, reaching a high in 1930–1931. Then it began to fall, slowly at first, but with increasing momentum. H. G. Arnsdorf, registrar of New York University, stated that many observers believe there will be a dearth of engineers within three or four years, since many who were trained in the profession, when faced with unemployment, turned to other fields which they would be reluctant to leave.

Data in the bulletin of the American Association of College Registrars show the enrolment in engineering courses in 143 universities and land-grant colleges to have been as follows: 49,280 for the year 1929–1930; 52,887 for 1930–1931; 47,860 for 1931–1932; 47,754 for 1932–1933; and 39,435 for 1933–1934. As yet the figures for 1934–1935 have not been compiled.

The following figures show percentage reductions from 1930–1931 to 1933–1934, computed on the basis of attendance in 1930–1931:

Agricultural and Mechanical College of Texas	29 per cent
Cornell University	18 per cent
Ohio State University	38 per cent
University of Illinois	40 per cent
University of Michigan	16 per cent
University of Minnesota	22 per cent

Reductions in the six institutions listed may be taken as typical, since similar conditions exist at most of the other large engineering schools. The smaller colleges have in general experienced less decline, and one or two located in metropolitan areas have even increased their enrolment during this period, according to the news item referred to.

Harvard Fellowship Competition Announced

A FELLOWSHIP in city planning and traffic control for the school year 1935–1936 is announced by the Graduate School of City Planning of Harvard University and the Harvard Traffic Bureau. This fellowship is in the amount of $1,200, which is given by the Automobile Manufacturing Association for an approved program of intensive work, to be under the direction of the School of City Planning.

The competition is open to men in any department of any recognized college or university in the United States who are receiving a bachelor's degree this spring or have received one since January 1, 1933. The award will be made on the basis of the following: (1) a 1,500-word paper on "The Respective Fields and Interrelations of City Planning and Traffic Control Engineering in the Solution of the Vehicular Traffic Problem"; and (2) records of scholastic achievements and extracurricular activities.

The competition closes August 1, 1935. Requests for detailed information and fellowship application blanks should be addressed to The Chairman, School of City Planning, Robinson Hall Annex, Cambridge, Mass.

Stagnation in Tidal Basins

IN CONNECTION with determining the quantity of water that must be withdrawn from the surface of an enclosed body of sea water to prevent stagnation, C. G. Flebus, in the Park Department of the City of New York, has made a comprehensive summary of the literature on the various phases of this subject. Mr. Flebus' interesting collection of facts is divided into nine major parts, as follows: (1) stagnation effects on sea water and polluted tributaries; (2) sea weeds, fungi, and algicidal methods; (3) sea bacteria in relation to pathogenic bacteria; (4) prophylactic and bacterial effects of sunlight and ultra-violet rays; (5) purification effect of oxygenation; (6) collection of the most common species of seaweeds and algae from the area under consideration; (7) findings; (8) recommendations; (9) proposed construction of a lagoon between Hunters Island and Pelham Bay Park.

The bibliography includes the most recent data available. All the material to be found in the Engineering Societies Library and the New York Public Library has been consulted. The paper has been placed on file in the Engineering Societies Library, 29 West 39th Street, New York, N.Y., where it is available to those interested.

Revised American Standards Ready for Discussion

A RECENT announcement of the American Society of Mechanical Engineers states that two proposed standards are now being distributed for criticism and comment. The first of these, which represents a second revision of an earlier recommendation proposed in October 1928, is for rivets of $^1/_2$-in. nominal diameter and larger. The other proposed standard is for plain washers for use with American standard regular bolt heads and nuts.

Copies of these suggestions are available on application. All communications should be addressed to C. B. Le Page, assistant secretary, American Society of Mechanical Engineers, 29 West 39th Street, New York, N.Y. The Committee on the Standardization of Bolt Nut and Rivet Proportions and the Committee on the Standardization of Plain and Lock Washers are sponsored jointly by the American Standards Association, the Society of Automotive Engineers, and the American Society of Mechanical Engineers.

Most Beautiful Bridge in Steel

EACH YEAR the American Institute of Steel Construction invites a jury of engineers and architects to select the most beautiful steel bridge in each of three categories. Class A includes bridges costing $1,000,000 and over, Class B those costing between $250,000 and $1,000,000, and Class C those below $250,000. For the year 1934 first prizes were awarded only in Classes A and C. In Class A the award went to the Bourne Bridge across Cape Cod Canal at Bourne, Mass., and in Class C, to Douglas County Bridge No. 667, a grade-separation structure near Omaha, Nebr. These will be decorated with stainless steel plaques by the Institute at appropriate ceremonies to be held this summer. The Bourne Bridge was designed by the engineering firm of Fay, Spofford, and Thorndike, of Boston, Mass., including Frederic H. Fay, Charles M. Spofford, and the late Sturgis H. Thorndike, Members Am. Soc. C.E. The Douglas County bridge was designed by Guy P. Dorsey, M. Am. Soc. C.E., Deputy County Engineer of Douglas County, Nebr.

Two bridges received honorable mention, the grade-crossing elimination structure carrying the Michigan-Central and Grand Trunk railroads over Woodward Avenue, Detroit, Mich., in Class B, and the Eel River Bridge at Smith Point, Humboldt County, Calif., in Class C.

Progress Demands Knowledge

UNDER THE TITLE, "Progress Demands Knowledge," the Engineering Index National Committee has issued a pamphlet describing the aims of the Index and the plan of campaign being followed to raise a working capital fund of about $160,000. The pamphlet explains the uses of the capital fund, now being sought—to meet operating deficits until the Index can be self-sustaining, to develop a business-like sales program, and ultimately to lower the price scale so that cost will not be a barrier to less prosperous individuals and organizations who could profitably use the index.

The plan of campaign is also outlined. The intention is to obtain contributions to the capital fund from the larger potential subscribers and to assist in the organization of local "area committees" in a dozen or more industrial centers. The National Committee for this fund has its headquarters at 25 West 43d Street, New York, N.Y.

Winners of Dudley Medal Announced

The winners of the Charles B. Dudley Medal for 1935 are C. A. Hogentogler, Assoc. M. Am. Soc. C.E., and E. A. Willis, Jun. Am. Soc. C.E., senior highway engineer and assistant highway engineer, respectively, of the U. S. Bureau of Public Roads. This medal is awarded annually by the American Society for Testing Materials to the author or authors of the outstanding paper constituting an original contribution to research in engineering materials presented at its annual meeting. New officers of the American Society for Testing Materials for 1935–1936 will be H. S. Vassar, president, and A. E. White, vice-president. C. L. Warwick, Assoc. M. Am. Soc. C.E., remains in office as secretary.

NEWS OF ENGINEERS

From Correspondence and Society Files

Hubert L. Schiflett, formerly an observer with the U. S. Coast and Geodetic Survey, is now employed by the Texas Company, with headquarters in Houston, Tex.

Albert Freitag has resigned as locating engineer for the Arizona State Highway Department to become an agricultural engineer in the Soil Erosion Service. His office is in Phoenix, Ariz.

Alfred D. Harvey has accepted the position of general manager of Spillway Builders, Inc., of Fort Peck, Mont. Previously he was assistant chief engineer for the Kansas City Bridge Company, of Kansas City, Mo.

Edward S. Brosell, who was formerly with the Ambursen Engineering Company, of New York, N.Y., has accepted the position of principal engineering draftsman with the Tennessee Valley Authority, in Knoxville, Tenn.

Russell H. Pedigo has been appointed chief engineer of the Bogue Phalia and Riverside Drainage Districts of Washington County, Mississippi, with headquarters in Greenville, Miss. Previously he was with the St. Francis Levee District of Arkansas.

F. W. Herring has resigned as assistant editor of *Engineering News-Record* to accept the position of assistant director of the American Society of Municipal Engineers and International Association of Public Works Officials, who have recently established a joint secretariat at 850 East 58th Street, Chicago, Ill.

Charles L. Hill has been appointed city engineer of Reno, Nev., following his resignation as division engineer for the Nevada Department of Highways.

Wilbur B. Ream has accepted an engineering connection with the Los Angeles County Flood Control District, with offices in Pasadena, Calif. He was formerly employed as designing engineer with the Middle Rio Grande Conservancy District.

Robert B. Pratt is now with the Petty Geophysical Engineering Company, serving as party chief in the field. His office is in San Antonio, Tex.

George W. Malone has resigned as state engineer and member of the Public Service Commission of Nevada to give his full time to consulting engineering. He has offices in San Francisco, Calif., Washington, D.C., and Reno, Nev.

G. A. Mott is now an engineer for Arthur Whitcomb, of Keene, N.H.

Walter B. Langbein has accepted a position as junior engineer in the U. S. Geological Survey, in which he has been assigned to stream gaging work. He was previously with the Rosoff Subway Construction Company, of New York, N.Y.

John E. Howe, formerly senior engineering draftsman for the Massachusetts State Department of Public Works in Boston, Mass., is now chief of party for the Rural Electrification Survey, with headquarters at Worcester, Mass.

Donald G. Elliott is now with the Angelo Newfoundland Development at Grand Falls, Newfoundland. He was previously connected with Monsarrat and Pratley of Montreal.

Robert E. Kennedy has accepted an appointment in the Department of Investigations and Project Studies of the U. S. Bureau of Reclamation.

W. J. Powell has been appointed supervisor of the City and County of Dallas (Texas) Levee Improvement District.

Bartow S. Bascome has taken a position with the New York State Public Service Commission, with headquarters in Albany, N.Y.

Clyde C. Key is now construction engineer of the Immigration Station at Ellis Island, N.Y.

Carl A. Powell has severed his engineering connection with the H. W. McKinley Company, of Oakland, Calif., to become mine engineer for the Stone Cabin Consolidated Mines, Inc., at Dayton, Nev.

Edward J. B. Dahlin, formerly assistant engineer of the District of Cook County Forest Preserve, has been appointed assistant highway engineer, Bridge Division, Springfield, Ill.

Changes in Membership Grades

Additions, Transfers, Reinstatements, Deaths, and Resignations

From May 10 to June 9, 1935, Inclusive

Additions to Membership

Anthony, James Aristotle (Jun. '35), 120 West 228th St., New York, N.Y.

Bell, Seaton June (Assoc. M. '35), Refinery Engr., Am. Petroleum Co. (Res., 709 West Alabama St.), Houston, Tex.

Billingsley, Earl Joseph (Jun. '34), 6114 Jackson St., Philadelphia, Pa.

Bowmaster, Wylie Albert (Jun. '35), With TVA (Res., 1207 Highland Ave.), Knoxville, Tenn.

Brooks, John Hapgood, Jr., (M. '35), Supt. of Sewers, City of Worcester (Res., 7 Chester St.), Worcester, Mass.

Brown, Marvin Thomas (Jun. '34), In Chg., Field Office, Russ Mitchell, Inc., 2701 Texas Ave., Houston, Tex.

Bruce, John Frederick (Jun. '35), Draftsman, State Highway Dept. (Res., 1601 South 20th St.), Lincoln, Nebr.

Byrne, Thomas Gorman (Jun. '35) 2127 Porter St., Philadelphia, Pa.

Cardwell, John Wesley (Assoc. M. '35), Engr., PWA; 3564 Eightieth St., Jackson Heights, N.Y.

Carpenter, Richard Townsend (Jun. '34), With National Aniline & Chemical Co.; 85 Chassin Ave., Eggertsville, N.Y.

Conrad, Frederick Xavier (M. '35), City Engr., City Hall, Port Jervis, N.Y.

Cordero Dávila, Juan César (Assoc. M. '35), Supt., Isabela Irrig. Service, Dept. of Interior of Puerto Rico, Box 195, Isabela, Puerto Rico.

Dees, Ben Woodall (Jun. '34), Pocahontas, Ark.

Detweiler, John Connett (Assoc. M. '35), Const. Engr. in Chg. of Water Works (Res., 2870 Howell St.), Omaha, Nebr.

Di Stasio, Joseph (M. '35), Cons. Engr. (J. Di Stasio & Co.), 136 Liberty St., New York, N.Y.

Giboney, David Francis (M. '35), Office Engr., John Monks & Sons-Ulen & Co., Serres, Greece.

Grimes, Benjamin Lyman, Jr., (Assoc. M. '35), San. Engr., City-County Health Dept., El Paso, Tex.

Hall, David Brewer (Assoc. M. '35), Asst. Engr., State Dept. of Public Works, Albany (Res., 24 Ellsworth Ave., Elsmere), N.Y.

HAVENS, ANDREW CANT (Jun. '34), Highway Engr., Research Dept., Am. Tar Products Co. (Res., 3115 Hazelhurst Ave.), Pittsburgh, Pa.

HEPBURN, DONALD OLIVER (Assoc. M. '35), Asst. Engr., CWA and W.D.D.P.W.; 42 Prospect St., Flushing, N.Y.

HOWELL, GILBERT PIERRE TRUXTON (Assoc. M. '35), Asst. to Chf. Engr., U.S. SES, Navajo Project (Res., 3200 Purdue Pl.), Albuquerque, N.Mex.

JONES, LEWIS HENRY, JR., (Jun. '35), Instrumentman, State Highway Dept. (Res., 533 Atlantic St.), Corpus Christi, Tex.

MCCARTY, THOMAS EDWARD, JR., (Jun. '34), 650 Granada Pl., Santa Fé, N.Mex.

MARTIN, EDGAR FLOYD (M. '35), Town Engr. (Res., 66 Nishuane Rd.), Montclair, N.J.

MAYZEL, STEPHEN DARLINGTON (Jun. '34), 9 West 84th St., New York, N.Y.

MONTAGUE, GEORGE ALFRED (M. '35), Superv. Engr., State Dept. of Public Works, Highway Div., 476 Main St., Worcester, Mass.

MONTILLA-COLL, NORBERTO (Jun. '35), Engr. in Chg., Puerto Rico Emergency Relief Administration, Box 751, Arecibo, Puerto Rico.

PAGÁN, PERDO CÓLON (Assoc. M. '35), Civ. Engr., Box 312, Guayama, Puerto Rico.

PAPPIN, GORDON FRANCIS (Jun. '35), Box 1432, Great Falls, Mont.

PEDIGO, RUSSELL HAYMAKER (Assoc. M. '35), Chf. Engr., Bogue Phalia and Riverside Drainage Dists., Weinberg Bldg., Greenville, Miss.

PHILLIPS, RICHARD DOUGLAS (Jun. '34), Senior Draftsman, U. S. Engrs. (Res., 5036 South East Lincoln St.), Portland, Ore.

RAHMAN, HAFIZ ABDUR (Jun. '34), Mastoi Rest House, P. O. Uch, Bahawalpur State, Punjab, India.

ROBEY, WALTER EARL (Assoc. M. '35), Bridge Designer, A. T. & S. F. Ry. System, 80 East Jackson Boulevard (Res., 7919 Drexel Ave.), Chicago, Ill.

SHAW, RALPH (Assoc. M. '35), Designer, Loup River Public Power Project, 8239 Eberhart Ave., Chicago Ill.

SPELLMAN, CLEMENS EUGENE (Assoc. M. '35), Bridge Designer, State Dept. of Public Works, Bureau of Roads and Irrig. (Res., 1820 Harrison Ave.), Lincoln, Nebr.

STEVENS, DUDLEY FIELD (Jun. '35), Care, Biological Survey, Box 1314, Minot, N.Dak.

TAYLOR, EDWARD HOLBROOK (Jun. '35), Box 218, San Anselmo, Calif.

WARD, SAMUEL (Assoc. M. '35), Prof. and Head of Dept. of Civ. Eng., Fenn Coll., Cleveland (Res., 2648 Canterbury Rd., Cleveland Heights), Ohio.

WHITE, ALFRED EVERETT (Assoc. M. '35), Div. Engr., State Highway Dept., Box 382, Keene, N.H.

WIGGINS, THOMAS EDWARD (Assoc. M. '35), Engr. in Chg., Works Div., FERA, Garvin County; Cons. Engr., 918 West Brooks, Norman, Okla.

WILSON, NEIL HAROLD (Assoc. M. '35), Chandlers Valley, Pa.

WINFREY, ROBLEY (Assoc. M. '35), Bulletin Editor and Research Engr., Eng. Experiment Station, Iowa State Coll., Ames, Iowa.

WORTH, HENRY NORMAN (M. '35), Chf. San. Engr., Dept., Medical and San. Service, Torrington Sq., Colombo, Ceylon.

ZERBE, JAMES JACOB (Jun. '34), 3034 West Bristol Rd., Flint, Mich.

ZUZZOLO, FRANK DOMINICK (Jun. '35), 14 West Sidney Ave., Mount Vernon, N.Y.

MEMBERSHIP TRANSFERS

ANDERSON, GEORGE HAROLD (Assoc. M. '28; M. '35), Superv. Engr., Franklin, Jefferson, and Union Counties; City Engr., Annex Bldg., Herrin, Ill.

BROWNFIELD, ALLEN HARRY (Jun. '32; Assoc. M. '35), Asst. Bridge Constr. Engr., San Francisco-Oakland Bay Bridge, 500 Sansome St., Room 800, San Francisco, Calif.

BURG, PHARO COLLINS (Jun. '23; Assoc. M. '35), Instrumentman, U. S. Coast and Geodetic Survey (Res., 948 Greenwood Ave.), Ann Arbor, Mich.

BURKE, EDWARD JOHN (Jun. '25; Assoc. M. '35), Draftsman, Bridge Dept., P. R. R., Room 351, Pennsylvania Station, New York (Res., 102 St. Marks Pl., Valley Stream), N.Y.

DESAI, DAHYABHAI SHIVABHAI (Jun. '28; Assoc. M. '35), Designer and Estimator, Braithwaite & Co. (India), Ltd., Box 427, Hide Rd., Calcutta, India.

DYER, HARRY BUTTORFF (Jun. '21; Assoc. M. '25; M. '35), Vice-Pres., Nashville Bridge Co., Nashville, Tenn.

HALE, HAROLD WINSLOW (Jun. '25; Assoc. M. '34), 105 Remington Pl., New Rochelle, N.Y.

HUTCHINSON, RALPH WHITE (Jun. '32; Assoc. M. '35), Associate Constr. Engr., San Francisco-Oakland Bay Bridge, 500 Sansome St., San Francisco, Calif.

INOS, JASPER HAROLD (Jun. '28; Assoc. M. '35), Foreman, Dept. of National Defense; 2 Water St., Charlottetown. P. E. I., Canada.

LABOON, FRAZIER PICKENS (Jun. '26; Assoc. M. '35), Asst. Highway Engr., U. S. Bureau of Public Roads (Res., 1627 Massachusetts Ave., N.W.), Washington, D.C.

LITTLEFIELD, WILLIAM MORRIS (Jun. '30; Assoc. M. '35), Asst. Engr., U. S. Geological Survey (Res., 708 East 12th St.), Rolla, Mo.

MCGEE, HENDERSON ENGLAND (Jun. '28; Assoc. M. '35), Junior Engr., U. S. Engr. Office, Room 208, Post Office Bldg. (Res., 3959 M St., Apartment B), Sacramento, Calif.

MILAN, ANTHONY GEORGE (Jun. '28; Assoc. M. '35), Res. Engr., Northumberland County, Works Div., Sunbury Emergency Relief Bureau, Sunbury (Res., 125 East Barnard St., West Chester), Pa.

OHLSEN, WALTER CLAUSE (Jun. '29; Assoc. M. '35), Structural Designer, State Highway Comm. (Res., 1128 North 2d St.), Ames, Iowa.

SMUTZ, HUBER EARL (Jun. '30; Assoc. M. '35), Zoning Engr., Dept. of City Planning, Room 361, City Hall, Los Angeles, Calif.

SOGA, SUSUMU (Jun. '28; Assoc. M. '35), Engr., Okura Doboku Kabushiki Kaishia, 3 Banchi Hasunuma-Cho Kamata-Ku, Tokyo, Japan.

STEWART, ALEXANDER CAMERON (Jun. '25; Assoc. M. '35), Associate Structural Engr., Procurement Div., Public Works Branch, Treasury Dept.; 294 Linden St., Waltham, Mass.

TALLAMY, BERTRAM DALLEY (Jun. '31; Assoc. M. '35), Cons. Engr. (Fretts, Tallamy & Senior), 5488 Main St. (Res., 33 Mill St.), Williamsville, N.Y.

VEATCH, FRANCIS MONTGOMERY (Jun. '15; Assoc. M. '19; M. '35), Cons. Engr., Black & Veatch, 4706 Broadway, Kansas City, Mo.

WISLER, CHESTER OWEN (Assoc. M. '19; M. '35), Prof., Hydr. Eng., Univ. of Michigan, 322 West Eng. Bldg., Univ. of Michigan, Ann Arbor, Mich.

YOUNG, PHILLIP GAFFNEY (Jun. '32; Assoc. M. '35), County Engr. and Surv., Refugio County; Cons. Engr., Town of Refugio, Box 25, Refugio, Tex.

REINSTATEMENTS

BARRON, MAURICE, Jun., reinstated June 3, 1935.

CARLSTEDT, HARALD, Assoc. M., reinstated June 3, 1935.

DRAKE, JAMES ALEXANDER Assoc. M., reinstated May 20, 1935.

GANNETT, FARLEY, M., reinstated May 13, 1935.

HARDY, NATHANIEL WHITE, Assoc. M., reinstated May 10, 1935.

HIESIGER, CHARLES MILTON, Assoc. M., reinstated May 14, 1935.

IRWIN, ORLANDO WILLIAM, Assoc. M., reinstated June 3, 1935.

KEARBY, JEROME PEYTON, JR., Assoc. M., reinstated June 3, 1935.

KENNOY, JOHN SHARP, Jun., reinstated May 13, 1935.

MELBY, GROVER ODD, Jun., reinstated June 4, 1935.

MORRISON, MAX ALLISON, Jun., reinstated May 22, 1935.

PHELPS, ZIBA BENNETT, JR., Jun., reinstated May 21, 1935.

SANDS, ROBERT LAWRENCE, Assoc. M., reinstated May 20, 1935.

WESTINGHOUSE, GEORGE FRANK, Jun., reinstated May 28, 1935.

RESIGNATIONS

CARSON, WALTER SIMPSON, Jun., resigned May 21, 1934.

HAINES, TRUMAN KNAUER, Jun., resigned May 29, 1935.

KETCHUM, ADDISON RAYMOND, Jun., resigned June 5, 1935.

PUFF, STEPHEN FRALEY, Assoc. M., resigned May 27, 1935.

RAY, FREDERICK CHAMBERLAIN, Assoc. M., resigned May 29, 1935.

WEDDINGTON, CHARLES FOREMAN, Jun., resigned May 28, 1935.

DEATHS

ANGILLY, CHARLES ENOCH, JR. Elected Assoc. M. June 6, 1927; M. June 27, 1932; died May 10, 1935.

HODGDON, JOHN BREWSTER. Elected Assoc. M. April 3, 1907; died March 16, 1935.

HOGUE, CHARLES JAY. Elected Assoc. M. Dec. 7, 1898; died May 28, 1935.

KOCH, EDWARD LOUIS. Elected Assoc. M. Nov. 26, 1918; died April 29, 1935.

LEMEN, WILLIAM CASWELL SMITH. Elected Assoc. M. July 10, 1907; M. Mar. 14, 1916; died April 7, 1935.

LOWETH, CHARLES FREDERICK. Elected Jun. Jan. 3, 1883; M. Feb. 6, 1884; died May 15, 1935.

LUM, DAVID WALKER. Elected M. May 3, 1893; died Dec. 26, 1934.

O'BRIEN, ARTHUR. Elected M. July 1, 1909; died April 25, 1935.

PALMER, JOHN ELDEN. Elected M. June 1, 1904; died May 19, 1935.

VAN WAGENEN, JAMES HUBERT. Elected Assoc. M. April 1, 1914; M. April 8, 1924; died May 17, 1935.

WILSON, CHARLES ALFRED. Elected M. April 1, 1891; died June 3, 1935.

TOTAL MEMBERSHIP AS OF JUNE 9, 1935

Members	5,692
Associate Members	6,147
Corporate Members	11,839
Honorary Members	18
Juniors	3,074
Affiliates	99
Fellows	2
Total	15,032

Applications for Admission or Transfer

Condensed Records to Facilitate Comment of Members to Board of Direction

July 1, 1935 Number 7

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in Civil Engineering *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

Grade	General Requirement	Age	Length of Active Practice	Responsible Charge of Work
Member	Qualified to design as well as to direct important work	35 years	12 years*	5 years of important work
Associate Member	Qualified to direct work	27 years	8 years*	1 year
Junior	Qualified for sub-professional work	20 years†	4 years*	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years*	5 years of important work
Fellow	Contributor to the permanent funds of the Society			

* Graduation from an engineering school of recognized reputation is equivalent to 4 years of active practice.

† Membership ceases at age of 33 unless transferred to higher grade.

The fact that applicants refer to certain members does not necessarily mean that such members endorse.

FOR ADMISSION

Ajwani, Hashu J., Khaipur Mir's, Sind, India. (Age 34.) Under J. R. Colabawala, State Engr. Refers to J. R. Colabawala, B. P. Fleming, B. J. Lambert, S. M. Woodward, D. L. Yarnell.

Alderson, Anthony Donald, Iowa City, Iowa. (Age 29.) Eng. Field Aide, U. S. Engr. Dept. Refers to A. S. Cutler, H. S. Loeffler.

Alewine, James K., Ft. Worth, Texas. (Age 30.) With Hawley, Freese & Nichols. Refers to J. D. Fowler, S. W. Freese, J. B. Hawley, F. R. Naylor, M. C. Nichols.

Allan, Robert Myers, San Francisco, Calif. (Age 24.) Engr., Standard Oil Co. Refers to A. S. Niles, L. B. Reynolds, J. B. Wells.

Altvater, Ralph Louis, Schenectady, N.Y. (Age 29.) With Schenectady County, ERB. Refers to E. R. Cary, L. W. Clark, V. G. Frisk, T. R. Lawson, W. W. Rousseau, H. O. Sharp, E. R. Wiseman.

Arnold, Hugh Montgomery, Barnesville, Ga. (Age 25.) Chf. of Party, Georgia Local Control Surveys, U. S. Coast and Geodetic Survey. Refers to J. deB. Kops, F. H. McDonald, C. C. Whitaker, C. W. Wright.

Banks, Thomas Gray, Oklahoma City, Okla. (Age 47.) Supt. and Engr. of Oklahoma City Water Dept. Refers to L. M. Bush, F. Herrmann, R. V. Lindsey, C. W. McFerron, B. S. Myers, W. E. Price, D. M. Wilson.

Bendel, Roland, Niles, Calif. (Age 48.) Div. Foreman, Alameda County (Calif.) Mosquito Abatement Dist. Refers to W. B. Boggs, H. F. Gray, C. G. Hyde, R. C. Kennedy, R. G. Wadsworth.

Bengtson, Thore Fritjof, Washington, D.C. (Age 26.) 2d Lieut., Corps of Engrs., U. S. Army. Refers to C. Derleth, Jr., G. E. Goodall, B. Jameyson, O. G. Stanley.

Berg, Paul Henry, Moscow, Idaho. (Age 21.) Refers to I. N. Carter, I. C. Crawford, J. W. Howard.

Berkey, Esto Ray, Manhattan, Kans. (Age 27.) Refers to L. E. Conrad, F. F. Frazier, M. W. Furr, R. F. Morse.

Berry, Donald Stilwell, Ann Arbor, Mich. (Age 24.) Refers to T. R. Agg, E. D. Dake, W. J. Emmons, W. S. Housel, F. Kerekes, R. L. Morrison, R. A. Moyer.

Blankenburg, William Luther, Lakewood, Ohio. (Age 21.) Refers to G. E. Barnes, F. L. Plummer.

Blum, Louis Mendel, Pittsburgh, Pa. (Age 22.) Chainman, Allegheny County Authority. Refers to L. P. Blum, W. E. Brown, J. T. Campbell, A. Diefendorf, C. G. Dunnells, R. H. Lee, L. C. McCandliss, W. A. Weldin.

Boone, Louis Crum, Rowesville, S.C. (Age 46.) County Engr., Orangeburg County, S.C. Refers to E. L. Clarke, J. H. Dingle, T. K. Legare. O. M. Page, L. W. Pollard, S. Quattlebaum. R. L. Sumwalt, W. W. Wannamaker, Jr.

Bracey, Smith Herbert, Algood, Tenn. (Age 30.) Jun. Engr., Tennessee Highway Dept., Chattanooga, Tenn. Refers to H. T. Ammerman, E. W. Bauman, T. L. Bransford, C. W. Butts, R. S. Lillard, J. E. Moreland.

Brumbaugh, John Ernest, Larchmont, N.Y. (Age 26.) Asst. Engr. of Larchmont. Refers to C. A. Latimer, A. Richards.

Bullock, Carlos DeWitt, North Platte, Nebr. (Age 27.) Designer, Platte Valley Public Power and Irrigation Dist., Sutherland Project PWA. Refers to K. F. Burnett, M. I. Evinger, P. F. Keim, H. J. Kesner, J. G. Mason.

Burke, Edmund Michael, New York City. (Age 32.) Regional Engr.-Inspector, Inspection Div., PWA, Region No. 1. Refers to F. J. Carew, F. O. Dufour, M. E. Gilmore, W. H. Gravell, A. S. Tuttle.

Burton, Harry Donald, El Paso, Tex. (Age 25.) Inspector, Texas State Highway Dept. Refers to R. E. Killmer, J. J. Ledbetter, Jr., J. G. Lott, J. T. L. McNew, S. R. Mitchell.

Campbell, William James, Saco, Mont. (Age 24.) Asst. Engr., Becker County Sand & Gravel Co. and J. L. Shiely Co. Refers to C. E. S. Bardsley, J. B. Butler, E. W. Carlton.

Carter, Odis, El Paso, Tex. (Age 23.) Refers to J. T. L. McNew, T. A. Munson.

Chamberlin, Wilbur Henry, Glasgow, Mont. (Age 27.) Inspector (Rivers and Harbors), Corps of Engrs., War Dept., Kansas City and Ft. Peck Dists. Refers to H. Allen, M. W. Furr, W. E. Gibson, N. T. F. Stadtfeld, L. V. White.

Conley, Francis Harry, Florence, Ala. (Age 29.) Prin. Eng. Aide (acting as Office Engr.), Eng. Service Div., TVA. Refers to E. W. Carlton, H. M. Clute. W. C. Dotson, P. B. Hill, T. E. Leahy, F. W. Truss, G. D. Whitmore.

Cooper, Irvin Aaron, Portland, Ore. (Age 21.) Refers to J. R. Griffith, G. W. Holcomb, F. Merryfield, C. A. Mockmore.

Cox, George Walter, San Antonio, Tex. (Age 22.) Refers to J. T. L. McNew, C. E. Sandstedt.

Cox, Harold Edward, Columbus, Ohio (Age 36.) With U. S. Geological Survey, Water Resources Branch. Refers to E. F. Coddington, N. C. Grover, J. C. Hoyt, L. Lee, C. G. Paulsen, D. L. Yarnell, C. V. Youngquist.

Crites, Everett Clay, North Platte, Nebr. (Age 33.) Field Engr., Portland Cement Association, Lincoln, Nebr. Refers to K. F. Burnett, D. L. Erickson, P. F. Keim, J. G. Mason, C. D. Miller, D. D. Price.

Cruickshank, Douglas Spencer, Los Angeles, Cal. (Age 26.) Refers to F. S. Foote, C. G. Hyde.

Davidson, Sam Norris, Eagle Lake, Tex. (Age 21.) Refers to J. T. L. McNew, T. A. Munson.

Dickson, Thomas John, Brighton, Mass. (Age 40.) Refers to J. G. Allen, R. W. Atwater, R. I. Colburn, H. A. Gray, S. C. Jemian, F. E. Leland, G. R. Rich.

Dvorak, John Jerry, Houston, Tex. (Age 22.) Draftsman and Designer, Humble Oil & Refining Co., Baytown, Tex. Refers to L. B. Ryon, Jr., L. V. Uhrig, W. E. White.

Egbert, Ford, Temple, Tex. (Age 26.) Refers to L. E. Grinter, J. T. L. McNew, T. A. Munson, J. J. Richey, C. E. Sandstedt.

Elliott, Karl Finley, Kress, Tex. (Age 24.) Refers to J. T. L. McNew, J. J. Richey.

Fahnwald, John, Bethlehem, Pa. (Age 47.) Chf. Estimator, McClintic-Marshall Corporation. Refers to E. F. Ball, S. W. Bradshaw, J. H. Fichthorn, W. A. Hazard, J. Jones, T. Leach, C. H. Mercer, H. T. Rights.

Flood, Frank Lee, Needham, Mass. (Age 27.) Asst. Engr., Metcalf & Eddy, Boston, Mass. Refers to E. S. Chase, H. P. Eddy, C. S. Ell, S. M. Ellsworth, A. L. Fales, N. L. Hammond, F. A. Marston, J. P. Wentworth.

Fock, Mo-Lun, Champaign, Ill. (Age 25.) Refers to F. A. Barnes, H. Cross, W. C. Huntington, J. E. Perry, F. E. Richart, L. C. Urquhart.

FRAZIER, JOHN WARREN, Manhattan, Kans. (Age 22.) Rodman, Kansas State Highway Comm. Refers to L. E. Conrad, E. R. Dawley, M. W. Furr, C. H. Scholer, L. V. White, R. B. Wills.

FREEMAN, JOSEPH HINES, San Marino, Calif. (Age 35.) Senior Draftsman, Los Angeles County Flood Control Dist., Los Angeles, Cal. Refers to S. M. Fisher, H. E. Hedger, N. B. Hodgkinson, A. Jones, O. D. Keese, W. W. Patch, F. W. Pore, M. E. Salsbury.

FRIEDMAN, HAROLD JAMES, Montgomery, Ala. (Age 43.) Highway Engr., U. S. Bureau of Public Roads. Refers to J. W. Barnett, J. H. Dowling, H. H. Houk, J. H. Johnston, R. D. Jordan, J. H. Mayer, S. B. Slack, C. W. Wright.

GRAHAM, THEODORE ROOSEVELT, Lincoln, Nebr. (Age 29.) Project Engr., Dept. of Roads and Irrigation. Refers to J. A. Bruce, H. J. Kesner, J. G. Mason, C. E. Mickey, C. C. Nicholls.

GRAHEK, JOSEPH LEWIS, Los Angeles, Calif. (Age 22.) Refers to B. A. Etcheverry, C. G. Hyde.

GRAY, GEORGE REINHART, Oakmont, Pa. (Age 21.) Refers to A. Diefendorf, L. C. McCandliss.

GREER, SYDNEY ROBERT, Tyler, Tex. (Age 21.) Refers to D. C. Greer, J. T. L. McNew.

HADLEY, WILLIAM ALONZO, Lakeland, Fla. (Age 36.) Asst. Div. Engr., State Road Dept. of Florida. Refers to C. N. Conner, T. M. Lowe, W. I. Nolen, J. R. Slade, D. Ulrich, C. M. Upham.

HAFTERSON, HAROLD DONALD, Lane, Idaho. (Age 27.) Refers to I. N. Carter, I. C. Crawford, J. W. Howard.

HAMILTON, DONALD MACKENZIE, East Cleveland, Ohio. (Age 23.) Student, under traveling scholarship from the Caird Trust, Dundee, Scotland. Refers to J. N. Ferguson, J. Forgie, S. C. Hollister, F. L. Plummer, W. J. Watson.

HAMILTON, WALLIS SYLVESTER, Williamsport, Pa. (Age 24.) Refers to C. G. Dunnells, F. J. Evans, F. M. McCullough, C. B. Stanton, H. A. Thomas.

HARDIN, ANDREW LEE, Waxahachie, Tex. (Age 21.) Refers to J. T. L. McNew, T. A. Munson.

HARRISON, JAMES KENNETH, Owensboro, Ky. (Age 31.) Refers to W. J. Carrel, D. V. Terrell.

HARVEY, KENNETH HOWARD, Glens Falls, N.Y. (Age 26.) Eng. Asst., Finch, Pruyn & Co. Refers to A. deH. Hoadley, W. C. Taylor.

HASSELBACH, WILLIAM HENRY, Toledo, Ohio. (Age 33.) Constr. Engr., Libbey-Owens Ford Glass Co. Refers to R. B. Daudt, A. S. Forster, A. Gardner, R. Nyquist, C. B. Patterson.

HOIDAL, CLARENCE RAYMOND, Troy, Idaho. (Age 24.) Refers to I. N. Carter, I. C. Crawford, J. W. Howard.

HOWARD, GEORGE WILBERFORCE, Vicksburg, Miss. (Age 23.) Jun. Engr., U. S. Waterways Experiment Station. Refers to D. M. McCain, P. V. Pennybacker, J. W. Pumphrey, H. A. Sargent, H. D. Vogel, C. P. Wright.

HOYEM, CARL HAAKON, Minot, N.Dak. (Age 24.) Dist. Engr., FERA. Refers to C. Johnson, R. E. Kennedy, D. W. Morrison, R. A. Pease, W. E. Smith, L. M. Winsor.

HUNT, LAWRENCE HALLEY, Rapid City, S.Dak. (Age 21.) Refers to A. A. Chenoweth, E. D. Dake.

JIMMERSON, DAVID CHARLES, Griffin, Ga. (Age 39.) Asst. Dist. Engr., Emergency Relief of Georgia. Refers to J. W. Barnett, B. P. McWhorter, G. N. Mitcham, P. Moore, W. R. Neel, C. L. Rhodes, S. B. Slack, C. W. Wright.

KELLER, FRANK, JR., Tucson, Ariz. (Age 24.) Refers to E. S. Borgquist, F. C. Kelton, J. C. Park.

KLEHS, HENRY JOHN WILHELM, Alameda, Calif. (Age 24.) Refers to O. W. Degen, F. S. Foote.

KLYCE, ERSKINE WATKINS, Helena, Mont. (Age 22.) Draftsman, Montana State Water Conservation Board. Refers to W. A. Coolidge, C. N. Harrub, F. J. Lewis.

KNAPP, ROBERT TALBOT, Pasadena, Calif. (Age 36.) Asst. Prof. of Mech. Eng., California Institute of Technology; also Cons. Engr., Los Angeles County Flood Control Dist., and Metropolitan Water Dist. of So. California. Refers to R. A. Hill, J. Hinds, C. T. Leeds, S. B. Morris, M. P. O'Brien, F. Thomas, T. von Karman.

KOCHMAN, EMIL JOSEPH, JR., New York City. (Age 24.) Eng. Asst., Grade 3, Dept. of Public Works, Div. of Design, Bureau of Eng., Survey Dept. Refers to F. E. Foss, G. Morrison, J. J. Murphy, J. P. J. Williams.

KOERNER, CLARENCE WALTER, Larned, Kans. (Age 31.) Senior Instrumentman, Kansas Highway Comm., Constr. Dept. Refers to C. M. Barber, L. E. Conrad, L. B. Fugitt, M. W. Furr, W. S. McDaniel, L. V. White, R. B. Wills.

KREUTZIGER, CARL HENRY, Chicago, Ill. (Age 30.) With Spooner & Merrill, Inc., Cons. Engrs. Refers to D. M. Cook, P. A. Fellows, L. M. Gram, W. C. Hoad, C. W. Spooner, L. C. Tschudy.

LANE, PAUL VAUX, Los Angeles, Calif. (Age 43.) Refers to L. O. Colbert, L. D. Gifford, A. C. Hardison, F. H. Hardy, T. A. Jordan, N. Thom, Jr.

LEE, GEORGE ADDISON, Zanesville, Ohio. (Age 24.) Jun. Computer, U. S. Army, Engr. Corps, Muskingum Conservancy Project. Refers to G. E. Barnes, W. E. Rice.

LENERT, LOUVA GERHARD, Jacksonville, Fla. (Age 47.) Asst. State Director, Malaria Control, Florida State Board of Health. Refers to R. M. Angas, A. Blair, W. W. Fineren, W. N. Jones, H. D. Mendenhall, M. Pirnie, G. W. Simons, Jr.

LEVEROCK, SIDNEY CLEMENT, Richmond Hill, N.Y. (Age 24.) Refers to F. E. Foss, G. Morrison, J. P. J. Williams.

LEVY, MORRIS, Irvington, N.J. (Age 35.) Instrumentman, U. S. Dept. of Interior, on Subsistence Homestead Project, Hightstown, N.J. Refers to J. L. Bauer, G. E. Chamberlin, W. G. Clark, H. W. Giffin, D. Ramsay, F. W. Tooker.

LINDSEY, HARRY MALVERN, JR. (Age 29.) Refers to E. S. Borgquist, F. C. Kelton, J. C. Park.

LUDWIG, JOHN HOWARD, San Pedro, Calif. (Age 22.) Chainman, Metropolitan Water Dist. of Southern California, Los Angeles, Cal. Refers to C. Derleth, Jr., B. A. Etcheverry, S. T. Harding, C. G. Hyde, F. C. Scobey, G. E. Troxell.

MCCARTHY, GERALD TIMOTHY, Zanesville, Ohio. (Age 26.) Associate Engr., U. S. Engr. Corps. Refers to A. L. Alin, F. G. Christian, T. T. Knappen, J. H. Lance, A. L. Pauls, E. D. Walker, L. R. Young.

MCDERMOTT, JAMES REED, Washington, D.C. (Age 40.) Senior Highway Engr., Region 7, U. S. Forest Service. Refers to J. P. Blundon, J. C. Dort, W. S. Downs, C. P. Fortney, H. J. Spelman, C. Swecker.

MCDONALD, EMMET JAMES, Bellevue, Pa. (Age 24.) Refers to A. Diefendorf, L. C. McCandliss.

MCEOWEN, ALBERT VINCENT, Indianapolis, Ind. (Age 21.) Refers to R. E. Hutchins, R. L. McCormick.

MCFARLAND, KIRK, Kansas City, Mo. (Age 43.) Pres., Hobson-McFarland Tractor Co. Refers to J. H. Brooking, W. A. Heimbuecher, G. F. Maitland, H. P. Mobberly, S. M. Rudder, W. M. Spann, E. O. Sweetser, H. P. Treadway, J. L. Van Ornum, E. C. L. Wagner.

MCREYNOLDS, JOHN WORTH, Bolivar, Mo. (Age 23.) Refers to A. L. Hyde, H. K. Rubey.

MADSEN, LYMAN WINN, Shelley, Idaho. (Age 22.) Refers to I. N. Carter, I. C. Crawford, J. W. Howard.

MANSUR, CLINE LEE, Norman, Okla. (Age 20.) Refers to J. F. Brookes, N. E. Wolfard.

METZGER, GEORGE RAYMOND, JR., Buffalo, N.Y. (Age 23.) Refers to P. S. Dow, R. Fletcher, F. W. Garran, C. A. Holden.

MITCHELHILL, JAMES MOFFAT, Evanston, Ill. (Age 22.) Refers to A. S. Hathaway, G. A. Maney.

MOORE, CHARLIE MARTIN, Austin, Tex. (Age 24.) Refers to P. M. Ferguson, J. A. Focht.

MORAVEC, JAMES GUILFORD, Iowa City, Iowa. (Age 24.) Engr., Iowa State Planning Board. Refers to J. J. Hinman, Jr., A. H. Holt, R. G. Kasel, F. T. Mavis, C. C. Williams, D. L. Yarnell.

MOSS, THOMAS LESLIE, JR., Columbus, Ga. (Age 29.) Chf. of Field Party, U. S. Coast and Geodetic Survey. Refers to J. E. Bomar, S. Gordy, B. H. Hardaway, Jr., F. H. McDonald, G. N. Mitcham, C. C. Whitaker, C. W. Wright.

OGRAM, ALFRED, Chillicothe, Ohio. (Age 36.) Superv. Constr. Engr., U. S. Bureau of Prisons. Refers to A. J. Cooper, E. W. Eickelberg, J. L. Goldman, C. K. Green, R. G. Hicklin, L. W. Robert, Jr., F. B. T. Siems, F. C. Snow.

OLSEN, LEROY, Brooklyn, N. Y. (Age 24.) Refers to H. R. Codwise, H. P. Hammond, E. J. Squire.

PARKER, WALTER MCFARLANE, Jacksonville, Fla. (Age 44.) Acting Chf. Engr., Florida ERA. Refers to B. L. Crenshaw, J. J. Gantt, T. H. Gardner, H. D. Mendenhall, S. Perkins, Jr., W. E. Robinson, H. N. Rodenbaugh.

PEAVEY, FRANK HARRIS, Twin Falls, Idaho. (Age 22.) Refers to I. N. Carter, I. C. Crawford, J. W. Howard, G. H. Miller, J. V. Otter.

PENSO, LEONARD EDMOND, Great Neck, N.Y. (Age 22.) Refers to F. E. Foss, G. Morrison, J. P. J. Williams.

PITTEL, HARRY LOUIS, Brooklyn, N.Y. (Age 25.) Asst. Engr., TERA. Refers to H. C. Ford, R. E. Goodwin, F. O. X. McLoughlin, F. G. Parisi, J. S. Peck, J. C. Rathbun.

POORE, GEORGE BENTLEY, San Francisco, Calif. (Age 66.) Vice-Pres., Calaveras Cement Co. Refers to N. B. Livermore, O. W. Peterson, T. Riggs, T. A. Stiles, W. Ward.

RIDER, EDWIN BURTON, Baltimore, Md. (Age 35.) Dist. Engr., Eng. Dept., Maryland ERA. Refers to F. H. Dryden, D. L. B. Fringer, F. L. W. Moehle, J. W. Richardson, S. L. Thomsen.

RINGEL, PHILIP, Brooklyn, N.Y. (Age 21.) Jun. Draftsman, B. P. M. (CWA). Refers to F. E. Foss, G. Morrison, J. P. J. Williams.

ROTH, WILLIAM HUGH, Topeka, Kans. (Age 23.) With Kansas Highway Comm. Refers to L. E. Conrad, F. F. Frazier, M. W. Furr, R. F. Morse, L. V. White.

ROWLEY, FLOYD RAYMOND, Livermore, Calif. (Age 24.) Jun. Engr., Standard Oil Co. of California, Civ. Eng. Dept., San Francisco, Cal. Refers to B. A. Etcheverry, J. M. Evans, C. G. Hyde, G. E. Troxell.

SCHNELL, LUCIUS JOHNSON, Perry, Ga. (Age 36.) Chf. of Party, U. S. Coast and Geodetic Local Control Survey, Atlanta. Refers to J. E. Bomar, L. V. Branch, S. R. Evans, S. Gordy, C. L. Rhodes, R. E. Rubins, A. R. Stuckey, C. W. Wright.

SHAPIRO, FREDERICK, Brooklyn, N.Y. (Age 21.) Refers to F. E. Foss, G. Morrison, J. P. J. Williams.

SMITH, ARTHUR RICHARDS, Indianapolis, Ind. (Age 44.) Engr. of Materials and Tests, Indiana State Highway Comm. Refers to H. F. Clemmer, R. W. Crum, A. T. Goldbeck, W. K. Hatt, M. R. Keefe, F. Kellam, J. S. Neibert, W. J. Titus, J. W. Wheeler.

SMITH, FRANKLIN EDWARD, Malad, Idaho. (Age 23.) Refers to I. N. Carter, I. C. Crawford, J. W. Howard.

SMITH, HENRY WILSON, Reno, Nev. (Age 26.) Refers to F. L. Bixby, H. P. Boardman, T. R. King.

SMITH, JOSEPH CHARLES, Pittsburgh, Pa. (Age 20.) Refers to A. Diefendorf, L. C. McCandliss.

SMITH, TRAVIS LOGAN, III, Wharton, Tex. (Age 27.) Refers to J. T. L. McNew, T. A. Munson, J. M. Nagle, W. A. Ortolani, A. P. Rollins, J. G. Turney.

Spellmann, Rudolph Randall, Smiley, Tex. (Age 23.) Refers to J. T. L. McNew, T. A. Munson.

Staubach, Arnold Baldwin, Austin, Tex. (Age 36.) State Bridge Engr., Texas State Highway Dept. Refers to R. V. Banta, J. H. Cissel, K. L. DeBlois, P. M. Ferguson, D. M. Neer, G. G. Wickline.

Stephenson, James, Wilmington, N.C. (Age 62.) Engr. of Reproduction Costs, Valuation Dept., Atlantic Coast Line R.R. Co. Refers to J. Q. Barlow, W. D. Faucette, E. M. Hastings, C. T. Johnston, C. A. Knowles, E. Mead, F. L. Nicholson, G. L. Swendsen, G. G. Thomas, J. E. Willoughby.

Stonesburner, Clifton Godfrey, Rosslyn, Va. (Age 22.) Refers to H. C. Bird, W. H. Hall.

Storms, Richard Edward, Oradell, N.J. (Age 22.) Refers to H. C. Bird, W. H. Hall.

Stuter, Emil, Shiner, Tex. (Age 21.) Refers to J. T. L. McNew, C. E. Sandstedt.

Sykes, Horace Fennell, Jr., Iowa City, Iowa. (Age 27.) 1st Lieut., C. E., U. S. Army. Refers to E. J. Dent, A. H. Holt, B. J. Lambert, F. T. Mavis, P. S. Reinecke, C. C. Williams.

Tafel, Louis Oliver, Pittsburgh, Pa. (Age 23.) Refers to A. Diefendorf, L. C. McCandliss.

Taylor, Bill Northcutt, Longview, Tex. (Age 36.) City Mgr. Refers to J. N. Edy, C. S. Lambie, J. T. L. McNew, E. N. Noyes, J. J. Richey, H. R. Safford, A. D. Stivers.

Taylor, John Robert, Jr., Dallas, Tex. (Age 22.) Refers to J. T. L. McNew, T. A. Munson.

Tempest, John Henry, Salt Lake City, Utah. (Age 52.) Partner, Mullins & Wheeler, Contrs. Refers to O. Bundy, H. S. Kerr, H. C. Means, C. E. Painter, F. H. Richardson, K. C. Wright.

Trimble, William Scott, Atlanta, Ga. (Age 29.) Sales Engr. in charge of eng. work, W. C. Caye & Co. (Div. of Wilson-Weesner-Wilkinson Company.) Refers to W. C. Caye, Jr., F. J. Lewis, W. C. Sensing, E. B. Wilkinson, C. A. Wilson.

Twigg, Oliver Charles, Oakland, Calif. (Age 26.) Refers to C. Derleth, Jr., F. S. Foote, C. G. Hyde.

Underhill, Alpheus Finch, Elmira, N.Y. (Age 28.) Engr. and Salesman in the southern tier of New York for the Federal Portland Cement Co., Inc., Buffalo, N.Y. Refers to F. A. Barnes, E. J. Moore, S. S. Neff, J. E. Perry, J. H. Stevens.

Vollmar, Alfred George, Richmond Hill, N.Y. (Age 22.) Refers to H. P. Hammond, L. F. Rader.

Von Schoeler, Waldemar Augustine, Nogales, Ariz. (Age 34.) Asst. Constr. Engr., International Boundary Comm. Refers to P. R. Burn, S. F. Crecelius, H. B. Elmendorf, L. M. Lawson, J. J. Ledbetter, Jr.

Walker, Weldon Ferdie, Stamford, Tex. (Age 21.) Refers to L. E. Grinter, J. T. L. McNew, T. A. Munson, J. J. Richey.

Ward, William Clyde, Adairsville, Ga. (Age 25.) Dist. Timekeeper, FERA, Rome, Ga. Refers to R. P. Black, B. M. Hall, Jr., P. Moore, F. C. Snow.

Webster, Marvin James, Iowa City, Iowa. (Age 31.) Surveyman and Jun. Engr., U. S. Engr. Office. Refers to R. G. Kasel, F. T. Mavis, D. L. Yarnell.

Withers, Warren, Chattanooga, Tenn. (Age 42.) Hydr. Engr., U. S. Geological Survey, Water Resources Branch. Refers to N. C. Grover, J. C. Hoyt, C. E. McCashin, J. W. Mangan, O. J. Miller, C. G. Paulsen, D. S. Wallace.

Woo, Chester, Los Angeles, Calif. (Age 22.) Refers to R. E. Davis, C. Derleth, Jr., B. A. Etcheverry, S. T. Harding, C. G. Hyde.

Zimmerman, Alfred Harvey, Waco, Tex. (Age 22.) Refers to J. T. L. McNew, J. J. Richey.

Ziobro, Stanley Joseph, Elizabeth, N.J. (Age 21.) Refers to A. Diefendorf, L. C. McCandliss.

FOR TRANSFER

FROM THE GRADE OF ASSOCIATE MEMBER

Brownlee, James Lawrence, Assoc. M., Denver, Colo. (Elected Feb. 28, 1911.) (Age 54.) Regional Engr., U. S. Forest Service. Refers to G. M. Bull, J. A. Elliott, R. Follansbee, E. C. Jansen, B. M. Jones, C. E. Learned, J. P. Martin.

Cummings, Robert Augustus, Jr., Assoc. M., Newton, Mass. (Elected Junior Sept. 11, 1917; Assoc. M. Dec. 14, 1925.) (Age 41.) Appraisal Engr. and Staff Adjuster, Phoenix Assurance Co., Ltd., Boston, Mass. Refers to R. A. Cummings, E. N. Hunting, G. A. Maney, L. C. Wason, B. Wilson.

Davila, Jorge Victor, Assoc. M., Santurce, Puerto Rico (Elected Junior Jan. 14, 1924; Assoc. M. Aug. 29, 1927.) (Age 35.) Associate Engr., Dept. of Health of Puerto Rico. Refers to E. B. Besselievre, M. Font, R. A. Gonzalez, R. Ramirez, A. S. Romero, E. Totti y Torres, C. del Valle Zeno.

Goudey, Raymond Freeman, Assoc. M., Los Angeles, Calif. (Elected Junior Dec. 3, 1921; Assoc. M. Aug. 31, 1925.) San. Engr., Bureau of Water Works and Supply. Refers to D. M. Baker, W. W. Hurlbut, C. T. Leeds, J. B. Lippincott, S. B. Morris, A. J. Smith, H. A. Van Norman.

Johnson, Ruben Cumby, Assoc. M., Columbia, S.C. (Elected Junior Oct. 1, 1926; Assoc. M. Feb. 10, 1930.) (Age 35.) Associate Prof. of Civ. Eng., Univ. of South Carolina. Refers to P. H. Carlin, D. T. Duncan, A. E. Johnson, T. K. Legare, W. E. Rowe, R. L. Sumwalt, L. A. Whitsit.

Kerr, Stanley Albert, Assoc. M., Inglewood, Calif. (Elected Oct. 1, 1912.) (Age 50.) Associate Engr., J. B. Lippincott, Cons. Engr., Los Angeles, Cal. Refers to R. M. Conner, J. B. Lippincott, J. Munn, R. M. Snell, K. Q. Volk, F. E. Weymouth, C. P. Williams.

McCandliss, Lester Chipman, Assoc. M., Pittsburgh, Pa. (Elected Nov. 28, 1916.) (Age 49.) Prof. of and Head of Dept. of Civ. Eng., Univ. of Pittsburgh. Refers to E. E. Bankson, L. P. Blum, A. Diefendorf, L. W. McIntyre, J. M. Rice, C. B. Stanton, W. A. Weldin.

Negrotto, Allen Joseph, Assoc. M., New Orleans, La. (Elected Aug. 9, 1920.) (Age 42.) Asst. State Engr., FERA. Refers to J. G. Bennett, F. N. Billingsley, J. F. Coleman, J. B. Converse, J. de Tarnowsky, A. T. Dusenbury, H. M. Gallagher, W. T. Hogg, J. A. McNiven, A. M. Shaw.

Nitteberg, Carl Theodore, Assoc. M., Ft. Worth, Tex. (Elected Jan. 15, 1923.) (Age 43.) Senior Highway Bridge Engr., U. S. Bureau of Public Roads, Dist. No. 6. Refers to J. C. Carpenter, J. D. Fauntleroy, N. B. Garver, N. E. Lant, J. M. Page, G. G. Wickline.

Sette, Francis Joseph, Assoc. M., Blacksburg, Va. (elected Nov. 15, 1926.) (Age 37.) Associate Prof. in San. Eng., Virginia Poly. Inst. Refers to J. A. Anderson, H. G. Baity, R. B. H. Begg, G. M. Fair, R. W. B. Hart, R. S. Royer, A. J. Saville.

Sheiry, Edward Slater, Assoc. M., Istanbul, Turkey. (Elected July 15, 1929.) (Age 35.) Prof. and Head of Civ. Eng. Dept., Robert Coll. Refers to J. B. Babcock, 3d, G. E. Barnes, F. Bass, C. M. Spofford, C. H. Sutherland, C. H. Tompkins.

Splitstone, Charles Harold, Assoc. M., Cleveland Heights, Ohio. (Elected Junior Sept. 5, 1905; Assoc. M. Oct. 5, 1909.) (Age 57.) Supt. of Constr., Erie R.R. Co. Refers to G. H. Burgess, C. Gilman, J. H. Herron, W. E. Jessup, C. A. Mead, C. H. Moore, E. P. Palmer, C. H. Paul, O. Singstad.

Trimble, Ralph McCoy, Assoc. M., Chapel Hill, N.C. (Elected Junior July 12, 1926; Assoc. M. Jan. 13, 1930.) (Age 35.) Associate Prof. of Civ. Eng., Univ. of North Carolina. Refers to H. G. Baity, E. D. Burchard, W. G. Geile, T. F. Hickerson, H. F. Janda, T. Saville, S. R. Webb.

Young, Lawrence Richard, Assoc. M., Zanesville, Ohio. (Elected June 6, 1927.) (Age 37.) Prin. Asst. to Engr., Corps of Engrs., War Dept. Refers to A. L. Alin, G. B. Archibald, W. P. Creager, G. C. George, J. D. Justin, R. M. Strohl.

From the Grade of Junior

Baxter, Samuel Serson, Jun., Philadelphia, Pa. (Elected July 12, 1926.) (Age 30.) Asst. Engr., Bureau of Eng., Surveys and Zoning, City of Philadelphia. Refers to E. R. Brooks, T. Buckley, A. Z. Hoffman, W. C. Reeder, W. E. Rosengarten, C. S. Shaughnessy.

Browning, Elmer Lawrence, Jun., Memphis, Tenn. (Elected June 9, 1930.) (Age 29.) Member of firm, Kenneth Markwell & Associates, Engrs. Refers to B. F. Bespalow, C. E. Boesch, L. L. Hidinger, R. McNicholas, K. W. Markwell, J. R. Newman, G. E. Tomlinson.

Cheney, Laurence Bradford, Jun., Hartford, Conn. (Elected Oct. 10, 1927.) (Age 32.) Regional Engr. for Statewide Projects, Connecticut Emergency Relief Comm. Refers to B. L. Bigwood, C. M. Blair, L. J. Carmalt, C. C. Kilby, C. J. Tilden, H. J. Tippet.

de Forest, George Parmenter, Jun., Troy, N.Y. (Elected Oct. 1, 1928.) (Age 32.) Refers to E. R. Cary, F. J. Keis, T. R. Lawson, W. W. Rousseau, A. H. Sabin, H. O. Sharp, G. R. Solomon.

Dunstan, Gilbert Hall, Jun., Los Angeles, Calif. (Elected Dec. 5, 1927.) (Age 32.) Asst. Prof. of Gen. Eng., Univ. of Southern California. Refers to A. B. Collins, R. M. Fox, V. M. Freeman, L. W. Irwin, J. E. Jones, F. H. Olmsted, D. M. Wilson.

Font, Gilberto Melquiades, Jun., Rio Piedras, Puerto Rico. (Elected Oct. 24, 1932.) (Age 32.) Res. Engr. of San Juan Dist., Div. of Constr., Maintenance and Repair of Insular Roads and Bridges, Dept. of Interior, San Juan. Refers to J. M. Canals, M. Font, R. A. Gonzalez, F. Pons, R. Ramirez, R. M. Snell, E. Totti y Torres.

Hiles, Robert Eugene, Jun., Ashdown, Ark. (Elected Oct. 1, 1925.) (Age 33.) Res. Engr., Arkansas State Highway Comm. Refers to H. Cross, M. L. Enger, N. B. Garver, F. A. Gerig, R. C. Gibson, O. L. Hemphill, W. A. Poe, W. W. Zass.

Hughes, Mervin Mark, Jun., Champaign, Ill. (Elected Aug. 15, 1932.) (Age 31.) Acting Senior Engr., ECW Camp 65, DPE, Marion, Ill. Refers to E. L. Chandler, C. P. Hughes, F. C. Lohmann, M. J. Orbeck, C. C. Wiley.

Ingram, Lon Cartwright, Jr., Jun. Lubbock, Tex. (Elected July 15, 1929.) (Age 30.) Res. Engr., Texas Highway Dept. Refers to O. V. Adams, G. A. Field, W. H. Garrett, J. T. L. McNew, J. H. Murdough, F. B. Ogle, J. J. Richey, H. N. Roberts.

Klein, Michael, Jun., New York City. (Elected Jan. 25, 1932.) (Age 31.) Senior Engr., Dept. of Parks. Refers to B. J. Ahearn, J. R. Aikenhead, D. M. Brown, A. E. Clark, H. B. Gates, E. G. Haines, A. Hardoncourt, C. D. Thomas.

Kuehne, Walter Frederick, Jun., St. Louis, Mo. (Elected Nov. 15, 1926.) (Age 32.) Contr. Engr., McClintic-Marshall Corporation. Refers to J. W. Davis, C. M. Denise, A. H. Fuller, C. H. Harlan, J. Jones, R. MacMinn, G. L. Taylor, E. P. Weatherly.

Massman, Henry Joseph, Jr., Jun., Kansas City, Mo. (Elected Oct. 1, 1928.) (Age 29.) Vice-Pres., The Massman Constr. Co. Refers to G. H. Hamilton, G. F. Maitland, H. P. Treadway, B. C. L. Wagner, O. A. Zimmerman.

Phelps, Ziba Bennett, Jr., Jun., Binghamton, N.Y. (Age 29.) With Nussbaumer & Clarke, Inc. Refers to O. W. Myers, G. H. Nolan, N. L. Nussbaumer, R. H. Suttie, J. C. Tracy, A. S. Tuttle, H. T. Ware.

Ratcliffe, Robert Charles, Jun., Montrose, Colo. (Elected Nov. 14, 1927.) (Age 32.) With Colorado State Highway Dept., Denver, Colo. Refers to P. S. Bailey, L. R. Douglass, R. L. Downing, F. R. Dungan, C. L. Eckel, J. E. Maloney, R. I. Meeker, M. B. Morris.

Schmidt, Edward Carl, Jun., Brooklyn, N.Y. (Elected Dec. 14, 1925.) (Age 32.) Engr., Works Div., TERA, New York City. Refers

to J. R. Aikenhead, E. W. Borough, W. Hauck, T. H. Jones, H. B. Machen.

SCOTT, MARION BURDICK, Jun., Rialto, Calif. (Elected Oct. 14, 1929.) (Age 32.) Refers to D. H. Barber, J. A. Baumgartner, W. E. Dickinson, J. S. Gatewood, N. C. Grover.

SMOCK, WILLIAM FRANKLIN, Jun., Fort Knox, Ky. (Elected Dec. 15, 1924.) (Age 33.) Jun. Engr., U. S. Govt., War Dept., Q. M. C. Refers to A. L. Cornell, Jr., J. J. Gantt, W. H. Hamilton, C. W. Lovell, W. C. Morris, A. D. Perkins, Jr., H. N. Rodenbaugh, H. E. Tyrrell.

STRUCK, HENRY EDWARD, Jun., Springfield, Ill. (Elected Nov. 15, 1926.) (Age 32.) Asst. Highway Engr., Illinois Div. of Highways. Refers to R. R. Benedict, G. F. Burch, E. D. Dryfoose, C. M. Hathaway, C. E. Morgan, W. N. Schroeder.

VARRERO, ANTHONY WILLIAM, Jun., Philadelphia, Pa. (Elected Feb. 10, 1930.) (Age 32.) Refers to E. G. Perrot, T. B. Rights, W. R. Sauter, J. Tempone, C. M. Wetzel.

WELLS, CHARLES, Jun., Topeka, Kans. (Elected June 9, 1930.) (Age 31.) Jun. Engr., Surface Waters Div., Water Resources Branch, U. S. Geological Survey. Refers to W. E. Dickinson, F. W. Epps, A. B. Griggs, G. S. Knapp, A. A. Laird, C. G. Paulsen, L. B. Smith, J. B. Spiegel.

WING, CHARLES HEQUEMBOURG, Jun., Buffalo, N.Y. (Elected March 11, 1929.) (Age 29.) Member of firm, Paris Constr. Co., Gen. Constr. Contrs. Refers to G. W. Carlton, S. T. M. Carpenter, D. Cornell, J. W. Cowper, E. P. Lupfer, T. M. Ripley, A. P. Skaer, G. F. Unger, F. K. Wing.

WOOD, WALTER JORDAN, Jun., Los Angeles, Calif. (Elected March 14, 1927.) (Age 31.) Asst. Chf. Hydr. Engr., Hydr. Dept., Los Angeles County Flood Control Dist. Refers to P. Baumann, J. H. Dockweiler, H. E. Elrod, S. M. Fisher, G. B. Gleason, H. L. Haehl, F. H. Hay, N. B. Hodgkinson, F. B. Laverty, L. B. Reynolds, M. E. Salsbury.

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.

Men Available

These items are from information furnished by the Engineering Societies Employment Service, with offices in Chicago, New York, and San Francisco. The service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 87 of the 1935 Year Book of the Society. To expedite publication, notices should be sent direct to the Employment Service, 31 West 39th Street, New York, N.Y. Employers should address replies to the key number, care of the New York Office, unless the word Chicago or San Francisco follows the key number, when it should be sent to the office designated.

CONSTRUCTION

ENGINEER AND SUPERINTENDENT; Assoc. M. Am. Soc. C.E., graduate civil engineer; age 36; 16 years experience general construction—supervised construction of hospitals, hotels, theaters, and office buildings. Desires employment with contractor or corporation. Location immaterial. B-5434.

CONSTRUCTION; Assoc. M. Am. Soc. C.E.; civil engineer; Wisconsin state license; university graduate; 12 years experience on roads, bridges, walls, etc., cost reports, surveying, office work, subdivision, supervision, and inspection. Salary or location no object if there is possibility of advancement and some degree of permanency. Available immediately. C-6632.

CONSTRUCTION ENGINEER; Jun. Am. Soc. C.E.; 32; married; B.S. in C.E., New York University; enrolled Alexander Hamilton Institute business course; 5 years as contractor's engineer, costs and construction, bridges, roads, bulkheads, foundations; 4 years with telephone company, engineer in charge—50 miles of conduit construction, 35 miles of conduit rearrangements. Desires responsible position with future. C-5622.

CONSTRUCTION ENGINEER; Jun. Am. Soc. C.E.; 31; B.S., C.E.; 8 years experience; desires connection with corporation or contractor. Over 5 years supervision, construction of suspension bridges. Over 1 year supervision, construction of sewage disposal plant and sewer lines. Over 1 year on railroad and coast and geodetic surveys. Experience reports of conditions of structures. Location immaterial. C-3758.

DESIGN

STRUCTURAL DESIGNER AND DRAFTSMAN; Jun. Am. Soc. C.E.; age 29; married; one child; B.S., California Institute of Technology; 15 months as designing engineer on new and reconstructed schools; 6 weeks on earthquake survey; at present, assistant to superintendent on construction of concrete school. Specialty—concrete design and indeterminate analysis. Desires permanent position. Will go anywhere. D-3438.

EXECUTIVE

ENGINEER EXECUTIVE; M. Am. Soc. C.E.; registered in Pennsylvania. Over 20 years experience, estimating, designing, sales, fabrication, and erection of steel structures, as well as directing supervisor of construction generally. At present connected with federal works program but desires substantial connection with some industrial concern as sales representative, or other responsible position. Available immediately. C-5095.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 39; family; university graduate; 12 years land surveys, topography, drainage, irrigation, estimating, hydrography and investigations, reports, design and supervision of water works, sewerage and paving projects; 9 years in responsible charge of large projects. Especially adapted to planning and the organizing and handling of men. Available on short notice. B-9735.

LICENSED CIVIL ENGINEER AND SURVEYOR; 35; 14 years excellent experience both field and office; highway planning and construction (specializing in grade-crossing elimination); industrial plant, hydro-electric plant, and water works construction; all types of surveys. Will go anywhere; moderate salary. Particularly interested, home construction. Represent building material supply house. D-3903.

CIVIL ENGINEER; M. Am. Soc. C.E.; B.S. and C.E. degrees; registered professional engineer, Pennsylvania. Over 20 years experience on construction of hydro-electric plants, power houses, industrial plants, railroads, and transmission lines, including purchase of rights of way. Proficient on appraisals, estimates, report writing, and investigations. Capable executive in field or office. A-4456.

EMPLOYED IN U. S. TREASURY; Assoc. M. Am. Soc. C.E.; 34; graduate of University of Michigan; Michigan professional license; 2 years as utility manager; 4 years in administrative charge of extensive municipal construction; 4 years in building construction. Demonstrated executive ability. Desires connection offering opportunity for advancement and future potentialities with established organization anywhere. C-3664.

ENGINEER; Assoc. M. Am. Soc. C.E.; 46; married; New York state professional engineer's license; 9 years experience, estimating costs and supervising construction of steam-distribution systems; 5 years as oil-field engineer; 4 years on railroad and highway construction. Desires position with steam-heating company. D-3901.

GRADUATE COAL MINING ENGINEER AND GEOLOGIST; M. Am. Soc. C.E.; prominent Eastern university; for 34 years has successfully directed major anthracite, bituminous coal corporations' engineering departments; has specialized in examinations of virgin and operating properties; operating cost analyses, appraisals, prospectings, developments; permanent-roof supports; mechanical mining, pnuematic, hydro preparation; mining economics, haulage, drainage, ventilation, mine safety, employees educational service. D-3678.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; desires position in any branch of civil engineering. Will also accept part-time research, compiling data; translations from Russian technical literature. Library experience for the last 18 months. Good knowledge of Russian literature. C-7182.

JUNIOR

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 28; single; B.S.C.E., Duke University, 1933; majored structural steel design and water supply; 1 month with U. S. Coast and Geodetic Survey; 3 months experience, water and sewage works; 3 years as inspector of telephone apparatus. Desires opportunity in any branch of civil engineering. Location immaterial. Available immediately. D-2683.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 23; single; B.S. in C.E., 1933. Majored in structural engineering; 4 months experience road-construction surveying; 5 months in drafting and design of large transport; 4 months experience bridge inspection. Desires position. Location immaterial. Available immediately. D-3554.

JUNIOR CONCRETE DESIGNER; Jun. Am. Soc. C.E.; additional experience in river hydraulics and erosion control; junior executive; contracting; married; age 31; prefers Mid-West location. Nine-year salary range has been from $1,800 to $3,000; Tau Beta Pi. D-3906.

ENGINEER; Jun. Am. Soc. C.E.; 24; B.S. in C.E. degree; learns easily; desires opportunity in branch of civil engineering; experience is main objective; salary secondary. Available immediately. Location immaterial, United States or foreign countries. D-3939.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 24; single; B.S. in C.E., Clarkson College of Technology, 1931; M.S., Massachusetts Institute of Technology, 1933. Specialized in water-power engineering and hydraulic models. Now temporarily employed by the U. S. Coast and Geodetic Survey. Desires position in the field of hydraulics. Location immaterial. D-3148.

ENGINEER SECRETARY; Jun. Am. Soc. C.E.; 23; B.C.E., University of Cincinnati, and complete secretarial training. Specially qualified for building, surveying, drafting, suspension bridge, breakwater, and general office work. Available immediately and location open. D-3974.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 24; single; 2 years as field representative; 1 year teaching. Wishes to enter engineering work in sales, office, or field. Specialized in water supply and structural engineering. Not afraid of hard work; strong. Location anywhere; engineering experience of primary importance. Available July 1. D-3972.